

[En]

T1200-64Q Tower Crane

Instruction Manual

T1200-64Q-138EN-D01

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INTRODUCTION

This document has been issued for the crane as defined at the time of ordering. **Please read carefully the instructions therein** before any crane operation.

Make sure that one complete copy of this document is always present at the location provided for on the crane, especially in case of crane rental or resale.

The safety signals, rating plates and instruction plates as well as this document are integrated part of the crane. In case of loss or damage of this instruction material you have order a new one from the manufacturer indicating the serial number and the crane type.

IMPORTANT: In case of a technical crane modification, please make sure that this instruction material will be updated.

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This document consists of 7 parts. The “safety instructions” part must compulsorily be read and under-stood by every operator. The other parts give specific instructions to the concerned operators for doing their tasks.

Part name	Part intended for:
1 DOCUMENTS	The crane operator
2 SAFETY INSTRUCTION	Everybody
3 TECHNICAL DATA OF CRANE AND SITE	Everybody
4 ERECTION/ADJUSTMENT/DISMANTLING	The fitter
5 OPERATION AND CONTROL	The crane driver
6 MAINTENANCE AND INSPECTION	The maintenance technician
7 SPARE PARTS	Everybody

Development of the technical instructions

ZOOMLION reserves the right, without prior notice, to improve the content and the form of this document. For each technical modification ordered or carried out after delivery, an updating will be supplied. On receipt of these new chapters, please insert them at the indicated space.

Warnings

The safety rules and the important observations which you must compulsorily observe are marked in the various parts of this documents by the following symbols:



Signaling of an important risk of body injuries and even mortal danger, if the described instructions are not observed.



Indicates the risk of equipment damage if the described instructions are not observed.

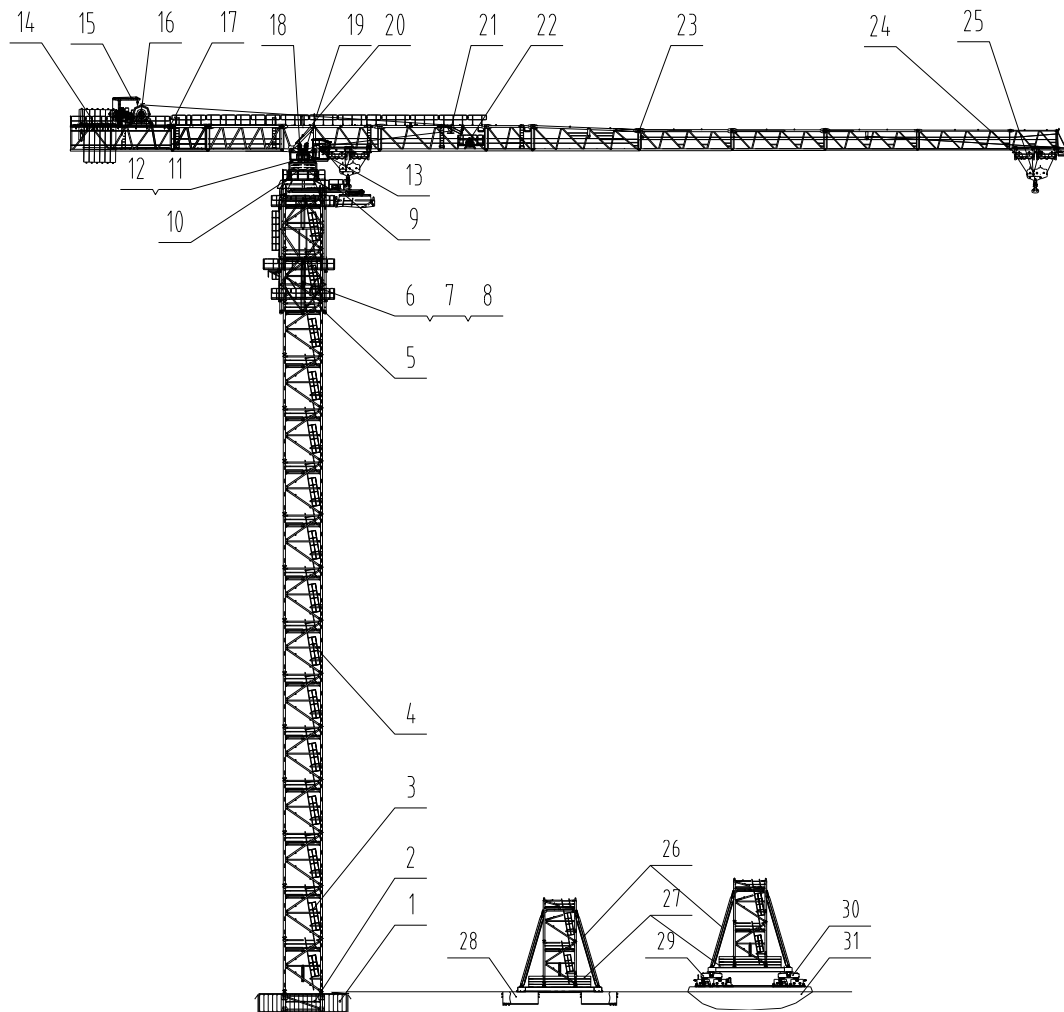


Important information



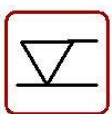
Note

TOWER CRANE VOCABULARIES

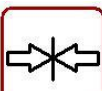
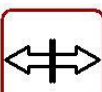


- | | |
|-------------------------------------|------------------------------------|
| (1) Outrigger stationary foundation | (2) Outrigger |
| (3) Base tower section | (4) Tower section |
| (5) Climbing equipment | (6) Climbing mechanism |
| (7) Climbing hydraulic cylinder | (8) Pump station |
| (9) Mounting device | (10) Slewing support |
| (11) Slewing ring | (12) Turntable |
| (13) Cabin | (14) Counter ballast |
| (15) Derrick | (16) Hoisting mechanism |
| (17) Counter jib | (18) Slewing mechanism |
| (19) Slewing mechanism | (20) Moment limiter |
| (21) Load limiter | (22) Trolley mechanism |
| (23) Jib | (24) Trolley |
| (25) Hook | (26) Chassis |
| (27) Central ballast | (28) Stationary chassis foundation |
| (29) Travelling bogie I | (30) Travelling bogie II |
| (31) Travelling chassis foundation | |

GRAPHIC SYMBOLS

SYMBOLS	SUBJECT
	FORBIDDEN
	STOPPING THE MOVEMENT
	COMPULSORY SAFETY HARNESS
	AUTHORIZED
	PARALLEL
	LEVEL
	LISTEN
	WEATHERVANE

SYMBOLS	SUBJECT
	SLEWING
	SLEWING LEFT
	SLEWING RIGHT
	HOISTING
	HOISTING UP
	FALLING DOWN
	TROLLEYING
	TROLLEY OUT
	TROLLEY IN

SYMBOLS	SUBJECT
	TRAVELLING FORWARD
	TRAVELLING BACKWARD
	CREEP SPEED
	LOW SPEED
	HIGH SPEED
	SM (2-fall rope reeving, used in 2-fall)
	DM (4-fall rope reeving, used in 4-fall)
	TIGHTEN-LOCK-PRESS
	LOOSEN-UNLOCK

METRIC SYSTEM AND IMPERIAL SYSTEM

1. CORRESPONDENCES

1.1 GEOMETRIC UNITS

Metric system		Imperial system		Values
Unit	Symbol	Unit	Symbol	
Lengths – distances				
meter	m	inch	in	1 m = 39.3700787 in
		foot	ft	1 m = 3.2808399 ft
		yard	yd	1 m = 1.0936133 yd
		mile	mi	1 m = 0.0006214 mi
Area or surface				
square meter	m ²	square inch	in ²	1 m ² = 1 550.0031 in ²
		square foot	ft ²	1 m ² = 10.7639104 ft ²
		square yard	yd ²	1 m ² = 1.195990 yd ²
Volume				
square meter	m ³	square inch	cu in / in ³	1 m ³ = 61 023.7438368 in ³
		square foot	cu ft / ft ³	1 m ³ = 35.3146666 ft ³
		square yard	cu yd / yd ³	1 m ³ = 1.3079506 yd ³
Flat angle				
revolution	r	radian		1 r = 2 π rad
		degree		1 r = 360 °
degree	°	radian		1 ° = 0.0174533 rad
		minute		1 ° = 60’
		second		1 ° = 3600’’

1.2 MECHANICAL UNITS

Metric system		Imperial system		Values
Unit	Symbol	Unit	Symbol	
Flow rate				
meter per second	m/s	mile per hour	mph	1 m/s = 2.2369 mph
		foot per second	ft/s	1 m/s = 3.28084 ft/s
		inch per second	in/s	1 m/s = 39.3701 in/s
Radian frequency				
radian per second	rad/s	radian per second	rad/s	1 rad/s = 1 rad/s
revolution per minute	r.p.m.	revolution per minute	rpm	1 tr/min = 1 rpm
Acceleration				
meter per square	m/s ²	foot per square second	ft/s ²	1 m/s ² = 3.2808399 ft/s ²
second				
Force				
Newton	N	kilogram force	kgf	1 daN = 1.0197162 kgf
		pound force	lbf	1 daN = 2.248 lbf
Moment of force				
Newton meter	N·m	force pound foot	lb–ft	1 N·m = 0.7375621 lb–ft
Energy. work. quantity of heat				
Joule	J	Watt–second	Ws	1 J = 1 Ws
Power				
Watt	W	Joule per second	J/s	1 W = 1 J/s
		kg–force meter per minute	kgf. m/min	1 W = 6.1182973 kgf.m/min
		horsepower (metric)	hp	1 W = 0.00135962 hp
Pressure. stress				
Pascal	Pa	pound per square inch	psi	1 Pa = 0.000145038 psi
		bar	bar	1 Pa = 0.00001 bar
		kg–force per square meter	kgf/m ²	1 Pa = 0.1019716 kgf/m ²
		Newton per square centimeter	N/cm ²	1 Pa = 0.0001 N/cm ²

1.3 MASS UNITS

Metric system		Imperial system		Values
Unit	Symbol	Unit	Symbol	
Mass				
kilogram	kg	pound	lb	1 kg = 2.2046226 lb
		ton (short)	ton	1 kg = 0.0011023 ton
Mass per unit length				
kilogram per meter	kg/m	pound per inch	lb/in	1 kg/m = 0.055997 lb/in
		pound per foot	lb/ft	1 kg/m = 0.6719689 lb/ft
		pound per yard	lb/yd	1 kg/m = 2.015905 lb/yd
Surface mass				
kilogram per square meter	kg/m ³	pound per square foot	lb/ft ²	1 kg/m ² = 0.2048161 lb/ft ²
		pound per square inch	lb/in ²	1 kg/m ² = 0.0014223 lb/in ²
		pound per square yard	lb/in ²	1 kg/m ² = 1.8433451 lb/yd ²
Density				
kilogram	kg	pound	lb	1 kg = 2.2046226 lb
		ton (short)	ton	1 kg = 0.0011023 ton
Mass per unit length				
kilogram per meter	kg/m	pound per inch	lb/in	1 kg/m = 0.055997 lb/in

1.4 UNITS OF TIME

Metric system		Imperial system		Values
Unit	Symbol	Unit	Symbol	
Time (duration)				
second	s	second	s	
minute	min	minute	min	1 min = 60 s
hour	h	hour	h	1 h = 60 min = 3600 s
day	d	day	d	1 d = 24 h = 1440 min
Frequency				
Hertz	Hz	Hertz	Hz	1 Hz = 1 s ⁻¹

1.5 ELECTRIC UNITS

Metric system		Imperial system		Values
Unit	Symbol	Unit	Symbol	
Strength				
Ampere	A	Ampere	A	
Voltage				
Volt	V	Volt	V	
Power				
Volt–Ampere	VA	Volt–Ampere	VA	
kiloVolt–Ampere	kVA	kiloVolt–Ampere	kVA	
Watt	W	Watt	W	
Electric resistance				
Ohm	Ω	Ohm	Ω	
Quantity of electricity. load				
Coulomb	C	Coulomb	C	
		Ampere·hour	Ah	1 Ah = 3600 C
Capacity				
Farad	F	Farad	F	

1.6 THERMAL UNITS

Metric system		Imperial system		Values
Unit	Symbol	Unit	Symbol	
Temperature				
kelvin	K	Kelvin	K	$^{\circ}\text{K} = (^{\circ}\text{F} + 459.7)/1.8$
		Celsius	C	$^{\circ}\text{C} = 5/9 * (^{\circ}\text{F} - 32)$
		Fahrenheit	F	$^{\circ}\text{F} = (9/5 * ^{\circ}\text{C}) + 32$

1.7 ACOUSTIC UNITS

Metric system		Imperial system		Values
Unit	Symbol	Unit	Symbol	
<i>Sound pressure and acoustic power</i>				
decibel	dB(A)	decibel	dB(A)	1dB=0.1B

2. EQUALITY BETWEEN FREQUENTLY USED UNITS

2.1 LENGTHS-DISTANCES

Metric system		Imperial system
1 centimeter (cm)	= 10 millimeters (mm)	= 0.3937008 inch (in)
1 decimeter (dm)	= 10 centimeters (cm)	= 3.937008 inches (in)
1 meter (m)	= 10 dm = 100 cm	= 1.0936133 yards (yd)
1 kilometer (km)	= 1 000 meters (m)	= 0.6213712 mile (mi)
Imperial system		Metric system
1 inch (in)		= 2.54 cm
1 foot (ft)	= 12 inches (in)	= 30.48 cm
1 yard (yd)	= 3 feet (ft) = 36 inches (in)	= 0.9144 m
1 mile (mi)	= 1 760 yards (yd)	= 1.609344 km

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1 DOCUMENTS

1.1 Sound pressure

The sound pressure (LpA) is measured at the level of the crane driver's ears by means of a microphone under the most unfavorable conditions: noisy winch, short counter jib.

Cranes with cabs:

Air conditioning at maximum level, windows closed, hoisting mechanism at low speed, hoisting/lowering with maximum load.

Air conditioning at maximum level, windows closed, hoisting mechanism at high speed, hoisting/lowering without load.

The highest value is taken for determining the sound pressure at the control unit.

Cranes with radio control:

The sound pressure level is given for a control unit which is at least 15 m away from the hoisting mechanism.

Sound pressure level measured in the cab or on the ground:

LpA (dBA)	Crane with winch in the jib	Crane with winch in the counter - jib
Not soundproof cab V140C or V140S	Sound pressure level = 79 dB(A)	Sound pressure level = 72 dB(A)
Sound proof cab V140SX	Sound pressure level = 76 dB(A)	Sound pressure level = 70 dB(A)
Control from the ground	Sound pressure level lower than 70 dB(A)	

1.2 Commissioning report

ZOOMLION		Email: service-hotline@zoomlion.com							
DELIVERY INSPECTION REPORT FOR ZOOMLION TOWER CRANE									
Report No.		Machine Model		Serial No.					
Region		Country		Service Date					
Customer Name			Location of Machine						
※ Mark the below corresponding symbols in right 'Result' columns according to the results of check.									
✓ Good Condition		X Bad Condition		✗ Correction Made					
Inspection Items		Result	Inspection Items		Result				
Visual Check	(1) The Actual Unpacked Attachments Conform with the Corresponding Shipping List.		Hoisting Mechanism	(1) Brake works reliably.					
	(2) The Actual Packed Attachments Conform with the Packing List.			(2) Hoisting limiter works properly.					
Erection	(1) Erection height of tower crane		Safety Device	(3) Tower Crane works properly at all hoisting and lowering speeds.					
	(2) Verticality of tower crane (design value: $\leq 4/1000$)			(1) Load moment limiter works properly.					
Hydraulic System	(1) Working pressure of pump station		Slewing Mechanism	(2) Weight limiter works properly.					
	(2) Pump station gets no oil leakage.			(1) Speed regulation for slewing to the left and right is smooth.					
	(3) All valves work properly.			(2) Brake works reliably.					
Trolleying Mechanism	(3) Slewing limiter works properly.		Electrical System	(3) Slewing limiter works properly.					
	(1) Reducer gets no oil leakage.			(1) Complete machine is well insulated.					
	(2) Brake works reliably.			(2) All electrical components work properly.					
	(3) Trolley moves smoothly.			(3) Motor works properly.					
	(4) Trolleying limiter works properly.		(4) Ground resistance of tower crane shall be no more than 4 Ω .						
	(5) Tower crane works properly at all speeds no matter for trolleying in or trolleying out.		Traveling Mechanism	(1) Dolly moves smoothly.					
				(2) Traveling limiter works reliably.					
Foundation Checks and Others					Yes	No			
(1) Foundation is made and maintained in accordance with drawings and instructions.									
(2) Make an clear explanation on rights and responsibilities of customer, Zoomlion warranty terms and conditions, service rules and so on.									
Detailed Description on Abnormalities Found during Delivery									
Delivery Date: 本设备于_____年(Year) _____月(Month) _____日(Date) 正常交付使用。									
Customer Comments and Suggestions									
		Very satisfied		Satisfied		Dissatisfied		Very dissatisfied	
		☐ 10' ☐ 9' ☐ 8' ☐ 7' ☐ 6'		☐ 5' ☐ 4' ☐ 3' ☐ 2' ☐ 1'					
		Signature of Customer							
		Customer Email/Phone No.							
Signature of Service Engineer									
Signature/Seal of After Service Provider				For Zoomlion Use Only					
ZOOMLION		ZOOMLION HEAVY INDUSTRY SCIENCE & TECHNOLOGY CO.,LTD.							

2 SAFETY INSTRUCTION

2.1 Foreword

The Safety Instructions describe the measures to be observed in order to reduce the risk of personal or material accidents when operating a crane. They are of utmost importance and must be consulted, comprehended, and applied by all parties intervening on the crane. A version translated into the language understood by the person consulting those instructions shall be supplied by the crane manager, if necessary.

Safety instructions figuring in the present chapter and based on the current state of knowledge at the time of their establishment are to be considered as simple guide-lines for the reader: ZOOMLION cannot anticipate in an exhaustive manner all the dangerous situations that may arise. Consequently, safety operation of the crane is a responsibility incumbent to yourselves.

Local regulations that are valid at moment of crane utilization may stipulate adherence to instructions that are more stringent than the present instructions, in which case those local regulations shall prevail.

The crane is a hoisting device destined for handling suspended loads on a protected operational site. It shall consequently be used exclusively for that purpose (cf. general utilization conditions chapter).

The crane has been designed in compliance with EC directives concerning safety, and to be used by professionals that are physically apt and qualified for the operation, assembly, piloting, and maintenance of this type of equipment (identified in the present manual as “competent persons”).

These persons must know the technical data (**Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>**) so as not to exceed the utilization limits described in this manual.



The illustrations of this part are general and do not correspond to your crane.

2.2 Intended use, misuse

The following describes the intended use of this ZOOMLION tower crane and warns against foreseeable misuse. Although the crane has been designed and manufactured according to the state of the art, it is not possible to completely eliminate all hazards that may occur during operation. The residual hazards, basic safety instructions, therefore draws particular attention to this.

Hazard prevention is carried out by:

- warning signs on the crane directly at the danger point,
- basic safety instructions for instructing the individual groups of persons in the operating instructions,
- action-related safety instructions before the activities described in the operating instructions.

2.2.1 Intended use

The design, manufacture, materials, equipment, operation, and maintenance of the ZOOMLION tower crane correspond to the state of the art, based on proven knowledge from science and technology. Nevertheless, its use may cause danger to life and limb of the user or third parties or damage to the crane and other property.

You may only use the crane in a safety-conscious and hazard-conscious manner, and in compliance with the operating instructions.

You may only use it for lifting, lowering, and horizontal load movements! You may only transport the load when it is freely suspended on the load hook! Damage and malfunctions which may impair safety must be rectified immediately!

Only skilled, instructed, and trained personnel may operate and monitor the crane from the crane operator's cabin and with radio operation.

The intended use, in particular the permissible loads for the crane components, is entered in the load tables in **Section 3.5.3**. They must not be exceeded under any circumstances! Immediately rectify damage and malfunctions which may impair safety!

You may only use base elements for this crane which have been approved by the manufacturer. When selecting the installation site for stationary cranes, it is essential to maintain safety distances

from overhead electrical cables, solid objects in the vicinity (structures, stacks of material, etc.), and embankments. When preparing the installation site for stationary cranes, be sure to observe the design guidelines for foundation construction.

2.2.2 Foreseeable misuse

The previous section describes the intended use of the crane.

Any other use or use going beyond this is not in accordance with the intended use and must be refrained from.

In the event of foreseeable misuse or improper handling of the crane, the manufacturer's EC declaration of conformity and thus the operating permit automatically expire.

Examples of misapplications:

- Pull loads horizontally over the ground,
- Increase load when it has left the solid base,
- Transport of swinging loads (use guide ropes),
- Overload from non-observance of the permissible load capacity,
- Diagonal pull,
- Tearing loads up and/or loose from stacks or jammed loads,
- Carriage of persons during load transport or on the reception facilities,
- Attach load hook, operation with slack rope,
- Assembly / disassembly of the crane at wind speeds above 14 m/s = 50 km/h,
- Continue working despite error/malfunction messages,
- Inadequate, removed, bypassed safety devices and indicators.

Improper use includes:

- Lifting of persons in normal operation,
- Use for demolition work such as with grab or wrecking ball,
- Modifications of the steel structure,
- Attachment of additional wind-impact surfaces (such as advertising boards) without the manufacturer's approval,
- Incorrect maintenance work and repairs,
- Omitted replacement of wearing parts,
- Maintenance intervals not observed,
- Operation without the necessary double safety devices,
- Operation at temperatures below -20 °C,
- Operation without required supervision/instruction personnel when the crane operator has little or no visibility of the load,
- Failure to carry out the inspection by an expert after each new installation/conversion, but at least once a year,
- Failure to carry out the inspection by an expert.

2.3 General conditions of use

The purpose of these general conditions is to explain the conditions indicated in **Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>**. In the event of unforeseen conditions, please contact us.

Certain critically important information on crane driving is represented in illustrated form in **Chapter 4 <ERECTION/ADJUSTMENT/DISMANTLING>** of the present manual.

2.3.1 Climatic and geographical conditions

A. Wind

Out of service, the crane operating conditions, i.e.: free standing height, ballast, reaction, and pressure under slab are determined by the storm reference wind speed measured at the crane installation site.

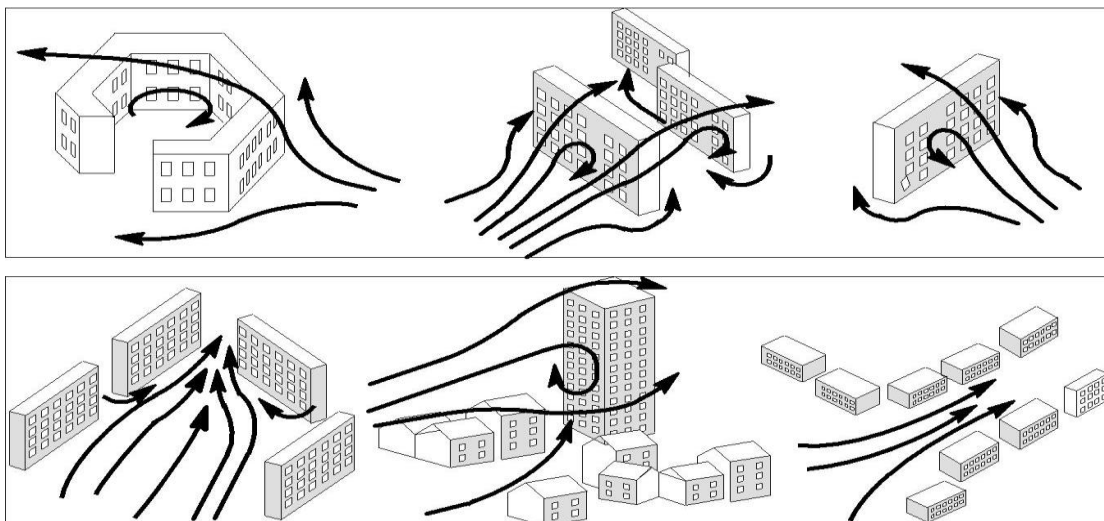
The storm wind speeds are described in the **Section 2.7**.

a) Specific conditions

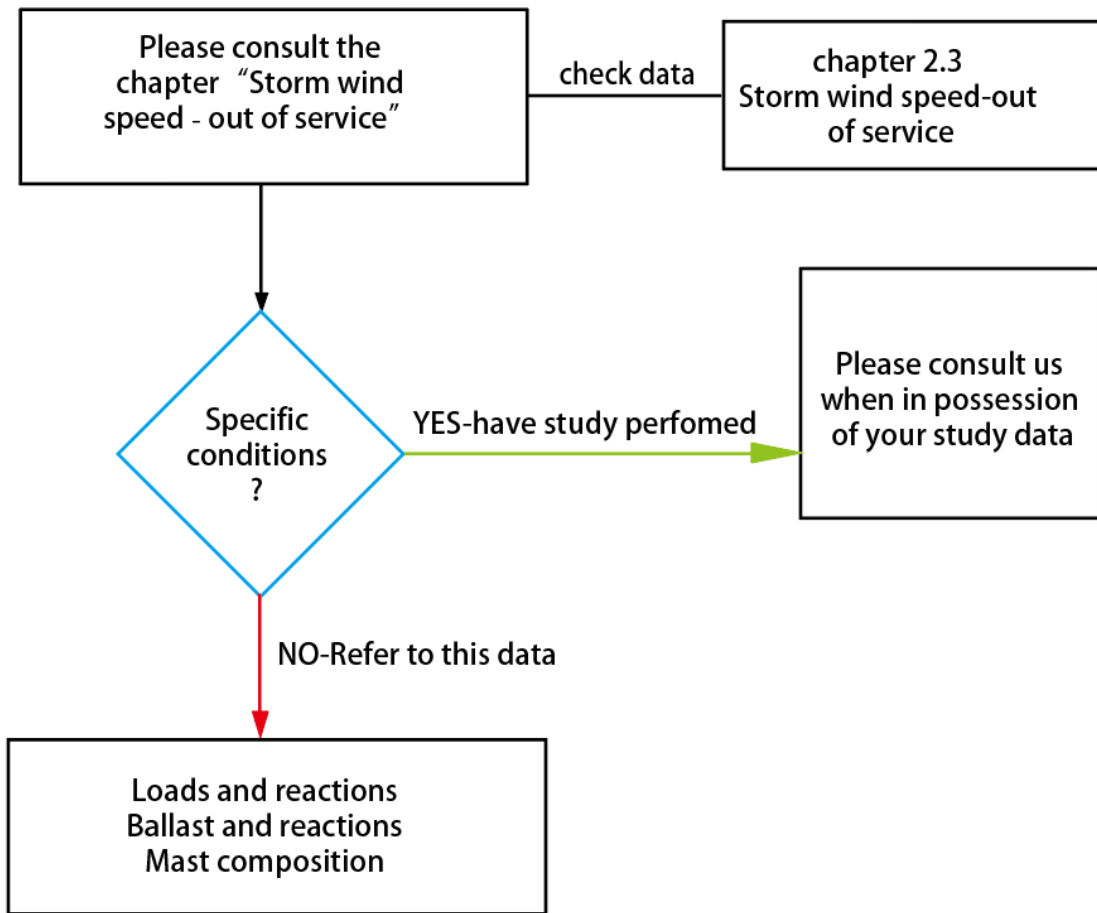
Some conditions or configurations require prior study on your part to determine the storm reference wind speed to be accounted for at the crane installation site. Please contact us when in possession of such data.

These conditions are:

- absence of map,
- national or local regulations,
- altitude higher than that indicated on your map if that is specified,
- bottom of hollow, narrow valley, hill top,
- isolated hill or mountain,
- cliff top,
- crane installed on a building,
- constructions: refer to the examples below.



b) Table for determination of crane operating conditions



c) Assembly, dismantling, change of configuration

Assembly, dismantling, change of configuration operations are possible only if the maximum wind speed (gust) measured at top of crane (cathead or strut) is lower than 14 m/s.

d) Crane in service

Use of the crane is possible only if the maximum wind speed (gust) measured at top of crane (cat head or strut) is lower than 20 m/s.

e) Surface exposed to the wind of the load handled

The surface exposed to the wind of the loads handled is considered as being less than or equal to 1 m²/t. If this value exceeded, the "in service" wind speed must be limited to a value lower than 20m/s. The value to be taken into accounting is given in the table "Maximum admissible wind speed for a load surface higher than 1 sq. m/t" (see **Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>**).

For surface areas greater than those provided in the table, please consult us.

B. Ambient air temperature measured under cover

This corresponds to the temperature measured within a non-closed shelter, protected from wind and rainfall, located 2 m above ground and within a max. 100 m radius.

Except for specific provisions defined by contract (E.g.: country specifications), the range of temperatures for crane use is as follows:

- Crane in service: – 20 °C to + 40 °C:



In case of temperatures out of the above range, cease any work with the crane (risk of malfunctioning or destruction of the components by abnormal overheating).

- Crane out of service: – 25 °C to + 55 °C:



In the case of planned temperatures out of the above range, it is preferable to dismantle the crane. In every case, apply the instructions concerning the extended standstill of the crane in the maintenance part.

C. Humidity / rainfall

The maximum rate of humidity for crane use (in service and out of service) is of 95% without condensation, excepting specific contractual provisions.

The maximum rate of humidity for a stored crane (dismantled) is of 95%.

D. Height above sea level

The operation height above sea level should be less than 1000m. The type of motor and electrical device should be increased.

E. Chemical environment

The requirement of chemical environment refers to urban industrial standard.

F. Electromagnet environment

The electrical field intensity should lower than 10V/m, extra design is needed when the television tower or other intense electrical field exists.

The nylon rope is recommended when the tower crane locates near the transmit tower.

The requirements above are general requirements; extra appointment is needed when dealing with special requirements.

G. Frost, ice, or snow

Frost, ice, or snow increase the weight of the structure and its surface exposed to wind. Those conditions may generate damage to moving parts. They can also cause personnel to fall when accessing the drivers stand.



It is strongly recommended to avoid using a crane when the latter is covered with frost, ice, or snow.

H. Lightning

Lightning can generate current circulation in the crane framework and lead to a risk of electrocuting any person in direct or indirect contact with the crane. E.g.: on part of the steel structure, on a ladder, on ground when touching the crane or load.

Lightning may interfere with the operating of radio controls.



In the event of risk of storm, cease work and set crane to idle mode. Do not access the crane during a storm.



In the case where the driver does not have time to leave the crane (sudden storm), he should never attempt to leave the crane during the storm. The driver runs less risk if he stays in the driving cab if he avoids touching any controls.

I. Sand storms

After a sand storm, sand may have penetrated internal electrical and mechanical elements and plugged orifices.



Before restarting the crane, completely clean the electrical and mechanical elements and remove moving parts if necessary.

J. Flooding / tidal waves

The above conditions are not accounted for, excepting specific contractual provisions.

In the case of flooding or tidal waves crane stability is reduced, thus cease any work with the crane.

K. Earthquake

The crane is not designed to be seismic-resistant whatever the magnitude of the earthquake, excepting specific contractual provisions.

L. Special installations

The crane is not designed to be installed on moving foundations such as off-shore platform, barge, floating bin, etc. excepting specific contractual provisions.

M. Crane supports

Crane supports shall be designed to withstand the forces indicated in the crane technical data and implemented in strict compliance with the tolerances provided.

2.3.2 Conditions relative to crane design

A. Appropriateness of crane to the operating site

Appropriateness of the crane to the operating site is incumbent to the user.

B. Crane power supply

The crane has been designed to work with a power supply the values and tolerances of which must be strictly adhered to **Section 3.6.4**.



Non-adherence to the values indicated can lead to malfunctioning of the crane.

C. Driver control stand

According to options, the crane is driven from the cab or the control station on the ground. Driving can be radio-controlled or remotely controlled.

Safety devices (force, movement, speed limiters) prohibit use of the crane out of its normal operating conditions.

D. Safety devices

Safety devices (force, movement, speed limiters) prohibit use of the crane out of its normal operating conditions.



Never modify safety device settings, nor hinder their functioning or neutralize them.

E. Load indicator

The load indicator shall not be employed as a measurement tool.

F. Protective elements

Protective elements or devices prohibit access to dangerous areas. They must never be suppressed.



Never start up a crane before all the protective elements (e.g.: housings, life-lines, railings, trap-doors etc...) are set in place.

G. Nominal crane life duration

The nominal crane life duration corresponds to the minimum life duration accounted for when calculating the crane fatigue factor.

Except for specific contractual provisions, that nominal life duration is in conformity with the classification FEM 1.001 version 3.

It is evaluated separately and differently for the complete crane and its individual mechanisms.

H. Nominal steel structure life duration

This is expressed in hoisting cycles (1 hoisting cycle = hoisting of a load, slewing and/or trolleying of that load, lowering for laying down).

The classification group for single tower cranes is A4.

I. Nominal mechanism life duration

This is expressed in operating hours of the given mechanism.

The classification group for mechanisms depends on the type of crane and the given movement.

The classification group determines a nominal life duration according to mechanism load-supporting state.

The different values above are provided in **Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>**.

J. Mechanism working factor

The mechanism working factor is expressed by the percentage of: mechanism usage time / mechanism usage time + rest time) measured over 20 cycles per hour.

The working factor indicated for mechanisms in **Chapter 6 <MAINTENANCE AND INSPECTION>** must in no case be exceeded.

K. Weathervane

The crane shall be able to weathervane through 360°. If that is not possible, please consult us.

L. Customer advertising plates

The dimensions of these plates shall not exceed planned dimensions.

Installation of advertising plates in areas other than those specifically provided is prohibited without the written authorization of the manufacturer.

Attachment of plates is entirely incumbent to the customer.

M. Fire extinguisher

The supply and implementation of a fire extinguisher in the cab is incumbent to the user.

N. Modifications of the crane / welding

Without written agreement of the manufacturer, it is prohibited:

- to modify crane construction (E.g.: addition or renovation of elements, blow-torch work, welding, etc...),
- to adapt non-authorized accessories,
- to modify crane settings (E.g.: modification of pressures, tares, adjustment values, etc...),

- to perform welding operations on the crane.



Welding work under the load is prohibited if the load is not secured by electrically insulated hoists.

O. Adaptation of equipment / Replacement of parts

Any adaptation of equipment not supplied or recommended by the manufacturer and any replacement by parts which are not genuine spare parts or parts authorized by the manufacturer will be carried out under the entire responsibility of the user.

The user also has the responsibility for the consequences of these adaptations and replacements.

P. Surveillance of the crane / verifications

To ensure the crane is monitored, is kept in good working order, and is used safely, it shall be submitted to the verifications (frequent, periodical, and extended) described in **Chapter 6 <MAINTENANCE AND INSPECTION>**.

If they are stricter, the verifications and directives related to local regulations shall take priority over the instructions in this manual.

Update the crane's maintenance records according to the instructions supplied in the manual.

Q. Scrapping

Eliminate all used products such as oil, grease, batteries in conformity with the regulations prevailing at the site where the crane is used.

2.3.3 Crane installation conditions

A. Distance between crane and fixed obstacle

Adhere to the minimum regulatory distance between the pointing mobile part of the crane and fixed obstacles. In the absence of regulations, that distance shall be of at least 0.5 m on ground and 2 m for above ground elements.

B. Distance between crane and overhead electric line

Adhere to the safety distances imposed by the regulations at the operating site, concerning hoisting devices with suspended loads, between crane elements and overhead electric lines. In the absence of regulations, that distance shall be of at least 3 meters for voltages less than or equal to 50000 V, with the addition of 1cm per additional 1000 V above 50000 V.

C. Distance between 2 cranes

If several cranes are close to each other, the minimum safety distance between any individual part of a crane or its load must be greater than 2 m in relation to any individual part or load of another crane.

D. Safety distance at track extremities

Adhere to the safety distances imposed by the regulations at the operating site concerning hoisting devices with suspended loads, for track extremities.

In the absence of regulations, provide for a track length exceeding the end position planned for the crane by 6m, in order to account for the stopping distance and the safety distances for installation of end dampers.

E. Aircraft limiting lights

Use of the crane in areas close to airports or aerodromes, in the aircraft taking off or landing cone, dictates the necessity of daytime and/or nighttime limiting light installations.

Apply the regulations prevailing at the operating site.

2.3.4 Handling conditions

A. Handling equipment

The crane is destined for load handling with use of its hook.

The use of any hoisting equipment generating dynamic effects such as, for example, electromagnets, clutches, hammers, gathering buckets is prohibited.

B. Load handling

- Never hoist an incorrectly secured load.
- Never drag a load in oblique direction. The load must always be hoisted in line with the trolley.
- Never hoist a load adhering to the ground or other elements.
- Never increase the weight of a load when suspended on the hook.
- Never swing the load to rest it out of the admissible range.
- Never leave the driving stand with a load suspended on the hook.

C. Handling with 2 cranes

The use of 2 cranes to hoist one and the same load is prohibited.

D. Hoisting of persons

The crane is not designed for hoisting persons. Such usage, which may be authorized by national regulations concerning suspended-load hoisting devices, is the entire responsibility of the user.

E. Ballasting derricks

Ballasting derricks are reserved for the handling of ballast blocks and accessories provided for in the present manual. Any other utilization is prohibited.

F. Maintenance derricks

Their use is strictly reserved for loads lower than those indicated on the derrick.

2.4 General safety instructions

2.4.1 Requirements for personnel/qualification and duties



This section describes the required qualifications of the personnel employed. Only specially authorized personnel may work on the crane.

The contractor may only employ persons for independent work on the crane who:

- have reached the age of 18,
- are physically and mentally fit,
- have been instructed in the field of activity and have demonstrated their competence, know and be able to apply the applicable accident prevention regulations and safety instructions for crane operation,
- have understood the contents of the safety chapter and are able to apply and implement them in practice,
- have been trained and given practical instruction on the tower crane in accordance with their responsibilities, tasks and activities, have understood the associated technical documentation and can implement it in practice,
- reliably perform the tasks assigned to them as expected,
- a specialist is someone who is able to assess the tasks assigned to him and recognize hazards on the basis of his specialist training, knowledge, and experience,
- In your own specialist responsibility, you may only carry out activities for which training has been proven.

2.4.2 Duties and responsibilities

The following duties exist:

- of the operator in relation to the personnel deployed,
- of the personnel vis-à-vis the employer/operator.

Duties and responsibilities are divided:

- Operator/entrepreneur,
- Supervisors/departments heads,
- Crane operator,
- Other personnel for transport, assembly, dismounting, maintenance and repair, hoisters, banksmen, and experts.

2.4.2.1 Obligations of the entrepreneur

As the operator, the employer must designate a supervisor who is responsible for ensuring that the personnel assemble, dismounts, or converts the crane in accordance with the assembly/disassembly instructions.

The operator of this crane must ensure that the personnel:

- complies with the necessary safety and monitoring measures,
- attaches safety signs to the workplaces,
- attaches and makes known any necessary internal safety and work instructions,
- obtains and uses required personal protective equipment,
- is trained and instructed according to its responsibilities, tasks and activities on the crane, especially in all safety aspects and the avoidance of risks from, fatigue, and mental stress,
- has the technical documentation available,
- has the necessary work equipment at its disposal,
- maintains cleanliness and clarity on the crane,
- keeps maintenance and inspection intervals.

2.4.2.1.1 Accident prevention

In addition to the information given in this manual, observe the regulations applicable in the respective country of use.

Accident prevention regulations are primarily aimed at the employer and are intended to help him to implement his obligations arising from state occupational health and safety regulations, and to show him ways of preventing occupational accidents, occupational diseases, and work-related health hazards.

The employer can assume that he will achieve the required protection goals if he follows the recommendations of the accident prevention regulations. Other solutions are possible if they ensure safety and health protection in the same way. If special committees have identified technical rules for the specification of national occupational health and safety regulations, observe them as a matter of priority.

2.4.2.1.2 Periodic inspections

Observe the manufacturer's inspection instructions in the operating manual.

The entrepreneur must ensure that:

- a competent person inspects the crane as required, but at least once a year, depending on the conditions of use and the operating conditions,
- in addition, a competent person inspects the crane each time it is assembled and after each conversion,
- An expert inspects the crane at least every 4 years,
- in the 14th and 16th year of operation, and after that, an expert inspects the crane annually.

2.4.2.2 Duties of the superior

The supervisor / group leader of the personnel of this crane must ensure that:

- the corporate duties have been implemented and complied with, see **Section 2.4.2.1**.

In particular, he must ensure that the authorized personnel:

- is trained and instructed according to his responsibilities, tasks, and activities on the crane,
- is instructed and trained in all safety aspects, and observes the safety aspects,
- observes the specifications of the technical documentation,
- has received and is using the required personal protective equipment,
- uses the necessary work equipment,
- maintains cleanliness and clarity on the crane,
- keeps maintenance and inspection intervals,
- rectifies reported safety deficiencies immediately.

2.4.2.3 Duties of personnel

The personnel working on the crane is obliged to:

- observe internal safety and work instructions,
- report safety deficiencies immediately to the appropriate supervisor or department head,
- keep the required safety signs visible/readable at the workplace,
- work on the crane only in accordance with its responsibilities, tasks and authorized activities,
- avoid risks from noise, fatigue, and mental stress,
- observe the specifications of the technical documentation,
- use the required personal protective equipment,
- to use the necessary work equipment,
- maintain cleanliness and clarity on the crane.

2.4.2.4 Duties of the crane operator

Before starting work

- Check crane for obvious defects.
- Check brakes and emergency end stop devices.
- Check assignment of control unit and crane with wireless controlled tower cranes.
- Check the function of the hook safety device on the load hook.
- Check track system and running gear, if present.
- Before releasing the energy supply to the drive units, set all control devices to zero or idle position.

During operation

- Record inspections and defects found in the control book.
- Operate control devices only from control stands.
- Watch the load during all movements, or the pick-up devices during empty runs if this could cause hazards. If this is not possible, the crane operator may only steer the crane on the signal of a banksman.
- Give warning signs if necessary.
- Loads attached by hand may only be moved when there is a clear signal from the hoister, the banksman, or another responsible person designated by the employer. If you have to use signals, agree on them beforehand with everyone involved. If loads are improperly

attached, they must not be transported under any circumstances.

- As long as a load is suspended from the crane, you must have the control devices within reach.
- Do not accept an overload after the load moment limit switch has tripped.
- It must be possible stop started driving or turning movements without danger.
- Report all defects on the crane to the responsible supervisor, and when changing the crane operator, also to the person taking over.

Avoid the following:

- Pulling loads at an angle, swinging.
- Tearing loose fixed loads.
- Permit the transport of persons with the load or the lifting device, (exception: for example, concrete bucket with stand for operating personnel; however only with the approval of the competent supervisory authority).
- Carrying loads over people. Use pick-up devices that hold the load by magnetic, frictional, or suction forces without additional securing. In general, loads must not be carried over persons.
- Approach of end positions limited by end switches.

Stop the crane operation under the following conditions if:

- you cannot safely hold and take off the load in windy conditions;
- the wind speed exceeds the permissible limit of 20 m/s;
- the temperature falls below -20° C;
- defects occur that endanger operational safety.

At the end of work

- Before leaving the control stand, unhook loads, hoist or pick-up equipment, pull up hooks, release slewing gear brake, move trolley into rest position, set control equipment to zero or idle, shut off power supply.
- Secure the control unit for wireless control against unauthorized switching on before putting it down.
- Do not leave loads hanging on the unoccupied crane.
- Activate wind release.
- Fasten track-operated tower cranes with rail tongs; put crane in "out of service" position.

Regular maintenance

- Maintain ropes.
- Check ropes for damage.
- Check load display control device.
- Check protective covers.
- Check safety switches.

2.4.2.5 Expert

Observe the regulations on experts applicable in the country of use!

Only persons authorized by the supervisory authority (Employer's Liability Insurance Association) are deemed to be experts for the periodic inspection of tower cranes. Immediately send the test report to the supervisory authority responsible for the contractor (Employer's Liability Insurance Association).

2.4.2.6 Competent persons

Competent persons carry out periodic inspections on tower cranes.

A competent person is a person who, on the basis of its professional training and experience, has sufficient

knowledge of tower cranes and is familiar enough with the relevant state occupational health and safety/accident prevention regulations, guidelines, and generally recognized rules of technology

to be able to assess the safe working condition of tower cranes.

In addition to the competent persons, you can also use specially trained personnel as experts, provided

they have experience and sufficient knowledge to assess the safe condition of the crane to be inspected.

2.4.2.7 Crane operator

The crane operator is primarily responsible for the intended use of the crane. His responsibility must be precisely defined and adhered to, also in the case of traffic route regulations. Instructions from third parties are not binding on him.

Keep and store tools, operating materials, and loose objects safely. Keep ascents, handholds, railings, and platforms clean and, in winter, free of ice and snow.

The crane driver must familiarize himself with the conditions at the construction site at the location. Obstacles in the work area must be known, and the construction site must already be secured to public traffic.



Any working method endangering the crane stability is prohibited!

After work, the crane operator must ensure that all operating elements and equipment are switched

off or set to the neutral position.

Before leaving the crane, the crane operator must secure it against accidental and unauthorized use.

See corresponding sections in *Chapter 5 <OPERATION AND CONTROL>*.

2.4.2.8 Banksman

The use of a banksman is mandatory when transporting loads that you cannot see.

The banksman gives instructions to the crane driver for certain operations. He must be able to observe the entire process without danger. The banksman must devote himself exclusively to control the work processes and the safety of persons being in the vicinity. He also pays attention to safety distances and danger areas which he closes off and secures them if necessary.

The banksman must be easily recognizable to the crane operator. Clothing should be conspicuously colored (signal color), preferably uniform, and be reserved for the banksman.

Communication takes place by means of defined hand signals, or radio telephony. Radio is best. If the working areas of several cranes overlap, you must define, plan, and coordinate the processes with all parties involved.

2.4.2.9 Hoister

The hoister attaches a wide variety of loads to the hook.

For the smooth transport of load, only the signs of the banksman are decisive, who must observe the hoister closely and follow his signs. They communicate by means of defined hand signals, or radio telephony. Radio is best used when you cannot see the hoister or the banksman.

Loads may only be attached by instructed, trained, and authorized persons who have been instructed in the execution and function of the lifting equipment.

2.4.2.10 Assembly personnel

Only trained personnel instructed by ZOOMLION may be used to assemble a crane. The foreman is responsible for supervision and has the authority to issue instructions.

The installation personnel must always observe the local regulations and occupational health and safety when working.

2.4.2.11 Supervisor

The employer must designate a supervisor who is responsible for ensuring that the personnel assemble, dismounts, or converts the crane in accordance with the Erection instructions.

2.4.2.12 Maintenance/repair personnel

Specialists maintain and repair the crane. They can use work stands or platforms if they cannot work from the ground (accessible area on the crane).

However, this does not apply when the crane is switched on and during work:

- there is no danger of crushing or falling,
- there is no danger of touching live parts of electrical installations and equipment,
- voice or line-of-sight communication with the crane operator is possible.

2.4.2.13 Miscellaneous tasks

Danger from electrical voltage

The **employer and the crane operator** must ensure that persons in the vicinity of live parts of electrical systems and equipment can work safely on the crane.

Repairs of/modifications to the crane and its working area

Whenever repairs, maintenance, or modifications are carried out on the crane or in its working area, the employer must also order and monitor the following safety measures:

- Switch off crane, secure against unauthorized restart;
- Secure the danger area under the crane by blocking or by warning posts;
- Secure the crane so that other cranes cannot approach it;
- Inform the drivers of neighboring cranes about the type and location of the work.

This also applies to shift changes.

If these safety measures are inappropriate or inadequate for operational reasons, the employer has to order and supervise other, additional, or specifically prescribed safety measures.

Recommissioning after repairs and modifications

You may only operate the crane after the entrepreneur has released it. Prior to release, the entrepreneur or his representative shall satisfy himself that:

- the work is completed,
- the crane is again in a safe condition,
- all persons involved in the work have left it,

In case of modifications, an expert must approve the crane; see special instructions in the other chapters of this manual.

2.4.3 Workplaces

This section describes the workplaces that are directly or indirectly related to the crane.

2.4.3.1 Personal protective equipment against falls from a height (PPE)

For many maintenance/repair jobs on the crane such as on jibs, you cannot use workman baskets/ working platforms, etc., to work safely. Therefore, use your personal protective equipment against falls from a height (PPE) when doing so, and during any assembly / dismantling or retrofitting.



Caution about impact by heavy parts, missteps in areas without railings, tripping, wind, movement of the standing surface, etc. when you work at great heights.

Death, personal injury, or property damage are the result.

- Use a safety harness everywhere on the crane where you can fall, for example when you leave the railing-secured areas!
- Always use the safety ropes/braces fitted for securing.

Observe and comply with the regulations applicable in the country of use!

Accident prevention regulations are primarily addressed to the employer. They are to assist him to implement obligations arising from state occupational health and safety and/or insurance regulations, and show him how to avoid occupational accidents, occupational diseases, and work-related health hazards.

Before selecting and using PPE, the employer must determine the hazard(s). In doing so, he identifies hazards which technical or organisational measures can neither prevent nor minimise. The employer must specify the characteristics for the PPE in order to protect against the hazards mentioned. The hazards which arise or may arise from the use of the PPE must be taken into account.

If workplace conditions change, the employer must review the investigations.

The employer must document his findings on the basis of the risk assessment. If work characteristics and hazards are comparable, he can create joint documentation for several users. The PPE to be used must comply with the relevant regulations on the safety and health of users at work. Thereafter, an EC type examination must be carried out, a CE marking must exist, and a manufacturer's declaration of conformity must be available.

Before selecting the PPE, the employer must evaluate the products he intends to use to determine whether they:

- protect against the dangers to be averted without posing a greater danger by itself,
- are suitable for the prevailing workplace conditions,
- meet the user's ergonomic requirements and health needs,

- can be adapted to the user if this is required by the nature of the personal protective equipment against falls from a height.

Notes on the selection

Do not combine different fall arrest systems with each other!

For the use of PPE, the employer must draw up operating instructions containing all the information required for safe use, in particular the hazards according to the risk assessment, the behaviour during use and in the event of any defects found.

Instruction

The employer must instruct users before first use and as required, but at least once a year. The instruction must include at least:

- detection of damage;
- the specific requirements of the individual equipment;
- proper wearing;
- intended use;
- proper storage.

Maintaining / cleaning / storing PPE

The employer must ensure that defective parts of PPE are only replaced by parts that correspond to the original part.

Clean and maintain all PPE equipment as necessary and in accordance with manufacturer's instructions.

Keep your personal protective equipment safe and comply with the respective manufacturer's instructions.

Inspections

Users must visually inspect their PPE for proper condition and operation before each use.

Depending on the conditions of use and the operating conditions, the employer must have the equipment inspected by a competent person as required, but at least once a year, to ensure that it is in perfect condition.

By way of derogation from this, the contractor shall have fixed guides for the installation of equipment (rails and ropes) inspected by a competent person as required, but at least once a year, to ensure that they are in perfect condition.

2.4.4 Instructions relative to operating conditions

A. Regulations relative to suspended-load hoisting devices

- Adhere to local regulations concerning suspended-load hoisting devices for matters covering:
 - roadway traffic,
 - fire-fighting equipment,
 - protection of the environment,
 - radio-control transmission-reception frequencies,
 - periodical verifications.



The dangers linked to the utilization and configuration of the machine must be taken into accounting by the security services and rescue services during the analysis carried out by the inspection authorities.

B. Climatic circumstances

- Establish a procedure relative to the behavior to be adopted in the case of particularly climatic circumstances (E.g.: reduced-function operation, evacuation of the area). That procedure may be supported by a system of climatic condition forecasting implemented by the local meteorological department.

C. Access to crane / driving stand

- Access the driving stand via the access path provided, with the crane stopped.
- Access the driving stand with an elevated cab or personnel elevator only when the crane is stopped and in adherence to the maximum authorized carrying capacity.
- Keep the access paths and control station perfectly clean. In particularly, remove all waste, traces of grease or oil, spare parts, tools, etc. Store tools, accessories, and parts in the positions provided for that purpose.
- Access the crane with hands unhindered by any object, facing the crane and always maintaining contact at 3 points with its elements: ladders, railing, stairs, catwalks, railings, etc... (e.g.: 2 feet and 1 hand, 2 hands and 1 foot).

D. Malfunctioning

- In the case of malfunctioning, stop the crane until the risk has been assessed by a competent person.
- Immediately correct any malfunctioning liable to compromise safety.
- Enter all malfunctions in the crane's maintenance records.

E. Electric lines

- Define the procedure to be applied in the case of accidental contact between crane and electric lines under voltage (direct contact or start of an electric arc).

■ Examples:

- Do not leave the crane,
- Do not touch the metallic structure,
- Warn all persons outside that they must avoid approaching or touching the crane,
- Withdraw the crane from the danger zone,
- Have the electric line powered off then leave the crane.

F. Conditions for visibility

- Adapt the communication means to the visibility conditions at the site where the crane is operated, for example use transceivers or video systems.
- In the case of low light, do not use the crane without an appropriate artificial lighting.

2.4.5 Instructions relative to specific danger

A. Installation

- Make sure that the electrical system is complete and undamaged.
- Make sure that the electrical system has no condensation and humidity.
- The lifting lugs are recommended to be used during removals.
- The cabinet is recommended to be installed in predesigned position, and the number of fasten needs to meet the designer's needs.
- Fasten the screws with required torque (see details on **Section 6.12**), using recommended plane pad or spring washer.

B. Wiring

- Confirm the power is off and no residual voltage.
- Wiring should be conducted by professional.
- Do not wiring when wearing loose clothes or jewelry.
- Avoid the damage of wires.
- Wiring with required wiring diagram.
- Wiring with required wires.

C. Test run

- Confirm the validity of the cabinet's installation; turn on the power after closing the cabinet's door. DO NOT open the cabinet's door when operating.
- Confirm the tower and mechanisms operate in allowable range.

D. Maintenance and Checking

- High-voltage exists in the high-voltage terminal, please DO NOT touch them.
- Turn off the cabinet's door when operating. Close the related breakers and confirm no residual voltage when disassembling the elements.
- DO NOT maintenance, check or replace the element unless an appointed specialist. Take off the metal jewelry (watch, rings) before operating, using insulated tools when operating.

- Apply extra braking methods when checking any brake.
- DO NOT wiring or remove wires when the power is on.
- DO NOT Maintenance or checking when the weather is bad.
- Maintenance and checking are recommended to carry on in 20 minutes after power-off, the residual voltage or high temperature exists in some elements.
- DO NOT reform the electrical system.

E. Additional

- DO NOT operate other mechanism when climbing.
- DO NOT operate when the safety device is not installed or debugged.
- The operator should pass through professional training.

2.4.6 Safety instructions relative to the preparation of each operating phase

A. Transport

- Provide for access to the site where the crane is operated, suited to crane transport conditions and, if necessary, the transport of auxiliary equipment used for assembly–dismantling (ground resistance, climatic conditions, access ramp, maneuvering zone, etc.).
- Install signaling equipment before any transport by road.

B. Preparation of the site

- Ensure that the site where the crane is used meets all crane characteristics and utilization conditions.

a) Crane installation area

- Before installing the crane, study the constraints related to its operating site, such as:
 - local regulations concerning work above public buildings or other, above roads, railroads, fluvial canals, etc.
 - proximity to other cranes, to an airport, to electric lines, to a transmitter of electromagnetic waves, etc.
 - configuration of the terrain, resistance of ground, excavations, slope, underground structure, etc.
 - storage zones for elements used in crane assembly or dismantling, positioning of handling equipment, in order to determine the optimal crane position, in compliance with assembly–dismantling and operating conditions.

b) Power supply

- Ensure that the power supply conforms to crane data and possesses the mandatory protections.

C. Assembly-dismantling part**a) Preparation of assembly–dismantling**

- Establish a document, for the attention of the personnel at the crane operating site, that details the risks of assembly, dismantling or change of configuration operations and the appropriate protective measures.
- Before any assembly, dismantling, change of configuration (e.g.: raising on supports, passage to raised jib) of the crane, ensure with the relevant authorities that wind speeds will not exceed the maximum authorized speed (refer to utilization conditions) throughout the entire operation.
- Stake out the safety areas (zones for storage, handling, assembly, ...) when assembling, dismantling, or testing the crane, with the use of signaling prohibiting access to non-authorized personnel.

b) Assembly – dismantling – change of configuration

- Do not use the crane during assembly, dismantling or change of configuration operations.
- For any assembly or dismantling operations not covered by the normal procedures (example: constraints related to the crane operating site, malfunctioning during assembling or dismantling), please consult us.

D. Maintenance part**a) Preparation for maintenance**

- Stake out a safety area in the case of crane malfunctioning or during maintenance interventions, with the use of signaling prohibiting access to non-authorized personnel.
- Inhibit re-start of the crane on stoppage for intervention and signal that inhibition of re-start by a warning attached to the main switch.

b) Maintenance

- Do not use the crane during maintenance operations.
- For any non-standard maintenance operation, please consult us.

2.5 Residual hazards, basic safety instructions

The hazards were determined during the design and manufacture of the crane by a risk assessment in accordance with DIN EN ISO 12100 and EN 14439, and the risks were evaluated.

Constructively unavoidable residual hazards are named and explained

- in the basic safety instructions,
- and in individual chapters situation and/or action-related (specific warnings).

The safety briefing contains basic safety instructions to permanently influence your behavior in a positive way. Information of results and interrelationships promotes your understanding and leads to safety-conscious behavior.

Observing and practical implementation of generally valid specifications in the country of use will give you further suggestions and tips, such as:

- Accident Prevention Regulation "Principles of Prevention".
- Accident prevention regulation "Cranes".
- Accident prevention regulation "Winches, lifting, and pulling devices".
- Accident prevention regulation "Load handling attachments with hoist operation".
- EC Directive 89/391/EEC "Measures to encourage improvements in the safety and health of workers at work".
- EC Directive 89/655/EEC "Minimum safety and health requirements for the use of work equipment by workers at work".
- EC Directive 92/58/EEC "Minimum requirements for the provision of safety and/or health signs at work".

In particular, note the following in addition:

- Machine/system-specific safety regulations by the operator.
- Safety instructions in the suppliers' operational documentation.

Basic safety instructions with information on residual hazards are structured according to target groups and can be found for:

- All persons in this chapter.
- Storage and transport personnel in this chapter and in the **Section 3.4**.
- Assembly personnel in this chapter and in **Chapter 4 <ERECTION/ADJUSTMENT/DISMANTLING>**.
- Crane operators in the Safety section in **Chapter 5 <OPERATION AND CONTROL>**.
- Dismounting personnel in the Safety section in **Chapter 4 <ERECTION/ADJUSTMENT/DISMANTLING>**.
- Maintenance personnel in the Safety section in **Chapter 6 <MAINTENANCE AND INSPECTION>**.

2.5.1 Dangers on the crane

The operating manual is an essential part of the crane for safe and efficient operation, therefore:

- observe the operating instructions;
- keep operating instructions available on the crane;
- forward the operating instructions to all subsequent users.

An employee is an authorized person if it is instructed by the employer and informed about the dangers/hazards.

All persons on or near the crane are exposed to the following hazards:

- **DANGER! Incorrect lifting accessories.**

Loads fall down if inadequate/defective lifting accessories break.

Death, personal injury, or property damage are the result.

- ▶ Close off and monitor hazardous areas.
- ▶ NEVER work under suspended loads.
- ▶ NEVER swing loads over people. In exceptional cases, give a warning signal to clear the area.
- ▶ Only use sufficient, intact, and tested lifting accessories.
- ▶ Secure the load so that it neither slips nor tips. If the balance point shifts, overloaded lifting accessories tear.
- ▶ Regularly check and maintain ropes and lifting accessories.

■ **DANGER! Incorrect hoisting**

Loads crash if you hoist them at unsuitable positions and a part break.

Death, personal injury, or property damage are the result.

- ▶ Only attach loads to the intended and marked hoisting points.
- ▶ Secure inserted outriggers.
- ▶ Close off and monitor hazardous areas.
- ▶ NEVER work under suspended loads.
- ▶ NEVER swing loads over people. In exceptional cases, give a warning signal to clear the area.

■ **DANGER! Loose parts of overhead loads**

Loads crash when parts detach and fall off.

Death, personal injury, or property damage are the result.

- ▶ Secure loads so that they neither slip nor tip.
- ▶ NEVER deposit loose parts on the load! Remove loose parts, transport, or secure them separately if necessary.
- ▶ Close off and monitor hazardous areas.
- ▶ NEVER work under suspended loads.
- ▶ NEVER swing loads over people. In exceptional cases, give a warning signal to clear the area.

■ **DANGER! Overhead loads**

Suspended loads moving in a controlled or uncontrolled way strike persons or objects.

Death, personal injury, or property damage are the result.

- ▶ Close off and monitor hazardous areas.
- ▶ NEVER work under suspended loads.
- ▶ NEVER swing loads over people. In exceptional cases, give a warning signal to clear the area.
- ▶ Loads must not swing in order to keep the danger area small. Always use the guide rope.
- ▶ Wear safety helmet and safety shoes!

■ **DANGER! Overhead loads**

Suspended loads can bump or crush people / objects. Hoists come loose. Load slips, tips, or crashes.

Death, personal injury, or property damage are the result.

- ▶ Have the danger area cleared before hoisting the load.
- ▶ Be aware of the balance point when hoisting the load.
- ▶ The crane operator, banksman, and hoister must ensure that you can hoist the load safely.
- ▶ Lower the load and have it realigned/newly slung if it is suspended incorrectly.
- ▶ Hoist loads gently until the hoisting rope is taut. Jerky hoisting activates the overload protection and puts excessive stress on the load hook, hoisting rope, and crane.

■ **DANGER! Danger of collision and tipping due to new cranes in the working area!**

When you set up other cranes, the working areas may overlap.

There is a danger of collision.

Death, personal injury, or property damage are the result.

- ▶ The working areas of all cranes are to be coordinated and limited if necessary.
- ▶ Limit the working range.
- ▶ Notify site supervisors and service personnel.

2.5.1.1 Falling objects

■ **DANGER! Falling objects**

Objects such as dismantled components, tools, etc., fall due to wind, impact, or movement of the crane.

Death, personal injury, or property damage are the result.

- ▶ Collect tools and assembly materials such as pins and split pins, and stow them properly! Do not store or transport loose parts on the load!
- ▶ Persons without an order to work on the crane are not allowed to enter the construction site!
- ▶ Block off the danger area under the crane widely from unauthorized access, or secure it with warning posts.
- ▶ Wear safety helmet and safety shoes!

■ **WARNING! Falling objects**

Inadequately fixed advertising boards fall from a great height.

Death, personal injury, or property damage are the result.

- Adequately secure advertising boards.
- Also check the attachment of the advertising boards during inspections before putting the crane into service.

2.5.1.2 High voltage

■ **DANGER! Overhead lines, electrical high voltage**

When the crane approaches or touches electrical lines, it is live. If someone leaves or enters it, it discharges through the body.

Death, personal injury, or property damage are the result.

- ▶ Always work with a banksman when working near overhead lines. From the best possible

vantage.

point, it makes sure you stay within limits, and warns you immediately if you exceed them.

► Move the crane slowly near overhead lines. To prevent the load from swinging: Use polypropylene guide ropes. Manila or nylon ropes are unsuitable as they absorb moisture and conduct electrical voltage.

► After contact with the overhead line:

- Act prudently and in accordance with your instructions!
 - Do not leave or enter the crane! Keep a safety distance of at least 5 m, cordon off and secure the danger area.
 - Warn outsiders not to approach or touch the crane!
 - Do not leave or enter the crane until the touched / defective cable has been safely de-energized!
- The crane driver initiates further measures.

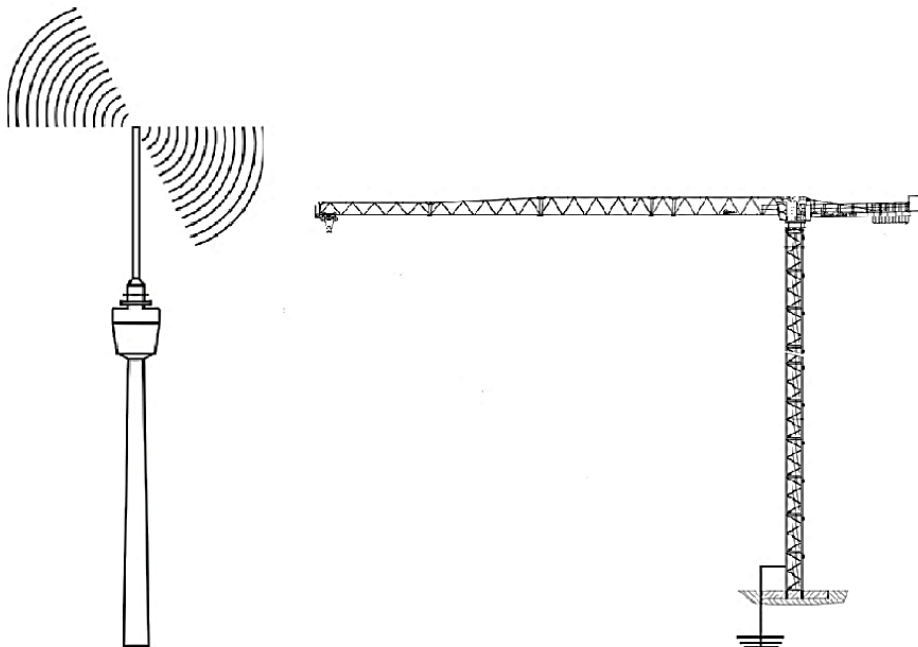


Fig. 2-1 Charging by electromagnetic fields - Ground the crane

■ **WARNING! Radio waves**

The crane jib charges itself like an antenna in the electromagnetic field of adjacent radio towers. If someone leaves or enters it, the voltage discharges through the body.

Death, personal injury, or property damage are the result.

- Ground the crane!

2.5.1.3 Lightning

■ DANGER! Lightning

Lightning can strike the crane during a thunderstorm. If someone leaves or enters it, the voltage discharges through the body.

Death, personal injury, or property damage are the result.

- ▶ Ground the crane in accordance with applicable legal requirements.
- ▶ Observe the local regulations for lightning protection when constructing the foundations. Check with the local acceptance authorities.
- ▶ Do not leave or enter the crane during thunderstorms.
- ▶ After a lightning strike, check the crane for damage (power supply, grounding).

2.5.1.4 Electrical voltage

DANGER! Electrical voltage

Dangers arise in electrical operating areas and on components:

- Live parts.
- Live parts due to faulty conditions.
- Parts under high voltage.
- Electrostatic processes and charges.
- Thermal radiation, ejection of molten particles, or chemical processes during short circuits or overload.

Death, personal injury, or property damage are the result.

- ▶ Only authorized electricians may work on electrical systems and their parts.
- ▶ Before working on electrical equipment/parts:
 - Comply with legal and local regulations.
 - Disconnect from power supply and check that no voltage is present.
 - Secure against restarting.
 - Cover adjacent live parts.

2.5.1.5 Danger of falling

■ DANGER! Falling

If you lose your footing or balance, you will fall. Causes: Misstep in areas without railings, tripping, wind, inattention, etc.

Death, personal injury, or property damage are the result.

- ▶ Unauthorized persons are NOT allowed to ascend the crane or use it.
- ▶ Notify the crane operator before entering the crane.

■ WARNING! Danger of falling

If you lose your footing or balance while ascending/descending, for example on slippery ascents, due to misstep, stumbling, wind, inattention, etc., you will fall.

Death, personal injury, or property damage are the result.

- ▶ Use the railing!
- ▶ Check steps and railings regularly for safety and clean them.

2.5.1.6 Wind

■ **DANGER! Strong wind, gusts**

You can no longer move bulky, large, and light parts in a controlled manner.

Death, personal injury, or property damage are the result.

- ▶ DO NOT lift light, large, bulky loads in strong, gusty winds!

2.5.1.7 Dangers from crushing and drawing in

■ **WARNING! Crushing/drawing in**

Danger of crushing and drawing in from unintentional start-up of the drive.

Death, personal injury, or property damage are the result.

- ▶ Before starting work, switch off the main crane switch, and secure it against being switched on again.
- ▶ Make sure that all drives are in a free of voltage.

■ **WARNING! Crushing/drawing in**

Danger of crushing/traction between gear ring and multi-turn actuator.

Death, personal injury, or property damage are the result.

- ▶ Only work on the gear ring when it is at a standstill! Switch off crane without wind release, secure against restarting: Lock the crane disconnecter. Brakes on the slewing gear are closed. Place a sign at the switch-on point indicating that maintenance is required.
- ▶ Keep clothing and hands away from the rotating drive. Wear tight-fitting work clothes and a hair net if required.

■ **WARNING! Crushing/drawing in**

Danger of crushing/pulling in between the hoisting rope and drum on the hoist gear.

Death, personal injury, or property damage are the result.

- ▶ Only work on the hoisting rope, brake, and rope drum when the machine is at a standstill. Switch off crane, secure against restart: Lock the crane disconnecter. Put a sign at the switch-on point indicating that maintenance is required.
- ▶ Keep clothing and hands away from the rotating drive. Wear tight-fitting work clothes and a hair net if required.

■ **WARNING! Crushing/drawing in**

Danger of crushing and pulling in between trolley rope and rope drum when the trolley gear is rotating. Death, personal injury, or property damage are the result.

- ▶ Only work on the trolley rope and rope drum when the machine is at a standstill. Switch off crane, secure against restart: Lock the crane disconnecter. Put a sign at the switch-on point indicating that maintenance is required.
- ▶ Keep clothing and hands away from the rotating drive. Wear tight-fitting work clothes and a hair net if required.

2.5.1.8 Other hazards

DANGER! Dangerous crane movements

During operation, the crane moves in a dangerous way. The cab protects the crane operator. Other persons on the crane are at risk.

Death, personal injury, or property damage are the result.

- ▶ Unauthorized persons are NOT allowed to ascend the crane!
- ▶ Notify the crane operator before allowing authorized persons to ascend or descend!
- ▶ The crane operator must interrupt or stop the crane operation to exclude any danger!

2.5.1.9 Large hook heights

For cranes with large hook heights, the weight of the hoisting rope reduces the maximum load that can be lifted; for details see **Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>**.

Liftable load = permissible load - additional weight of the hoisting rope.

2.5.1.10 Fire hazard

■ WARNING! Stability is endangered

If flammable or explosive substances ignite on the crane, they will damage the steel structure. Stability is then no longer guaranteed, and the crane falls over.

Death, personal injury, or property damage are the result.

- ▶ Do not store any:



fire-promoting,



combustible, or



explosive

substances in the vicinity of the crane!

NOBODY is allowed to enter or work in hazardous or work areas under the influence of alcohol, drugs, or mind-expanding substances!

2.5.2 Disposal and environmental protection



Environmental protection.

Recycle environmentally hazardous substances in accordance with the national regulations of the country of use.



Dispose of operating and auxiliary materials as well as replacement parts safely and in an environmentally friendly manner.



According to Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) of the European Parliament, do not dispose of this equipment with your normal household waste. Use the appropriate take-back systems of the municipality or a specialist disposal company with separate collection for electrical and electronic equipment.



Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) of the European Parliament prohibits the introduction onto the European market of new electrical and electronic equipment containing more than the maximum permitted levels of lead, cadmium, mercury, hexavalent chromium, fire retardant polybrominated biphenyl (PBB), and polybrominated diphenyl ether (PDBE).

2.5.3 Dangers during transport

■ **WARNING! Wrong shelves**

Transported loads fall or tip if they are placed on uneven or insufficiently stable surfaces.

Death, personal injury, or property damage are the result.

- ▶ Only place loads on level and sufficiently stable surfaces.
- ▶ Use a suitable base on soft ground.

■ **WARNING! Danger of falling**

If you work above body height, you will fall when you lose your footing or balance.

Death, personal injury, or property damage are the result.

- ▶ When working above body height, use appropriate safety access aids and working platforms.
- ▶ DO NOT use machine parts as climbing aids.

■ CAUTION! Sharp-edged machine parts

Sharp-edged machine parts cause serious injuries.

- ▶ Wear the required personal protective equipment during assembly/dismounting and repair.



Protective gloves



Safety shoes or boots



Safety helmet



Safety belt

■ WARNING! Incorrect lifting accessories

Loads fall down if inadequate/defective lifting accessories break.

Death, personal injury, or property damage are the result.

- ▶ Close off and monitor hazardous areas.
- ▶ NEVER work under suspended loads.
- ▶ Do not swing loads over people. If this is exceptionally necessary, give a warning signal to clear the area.
- ▶ Only use intact lifting accessories which are sufficient for the load.
- ▶ Secure the load so that it neither slips nor tips. If the balance point shifts, overloaded lifting accessories tear.
- ▶ Check and maintain ropes and lifting accessories regularly.

2.5.4 Dangers during assembly

2.5.4.1 General

■ DANGER! Incorrect assembly sequence, assembly interruption, crane falls over.

If the assembly sequence is not observed or is interrupted, you endanger the stability of the crane.

Death, personal injury, or property damage are the result.

- ▶ Adhere to the sequence of the individual assembly steps.
- ▶ Do not interrupt the assembly in order not to endanger the stability of the crane, for example in the event of a storm.
- ▶ From the step "Removing the concrete counter ballasts" to the step "Dismantling the counter jib", work must be carried on continuously!
- ▶ Place the required central ballast before erecting the tower and mounting the counter jib!

■ DANGER! Incorrectly loaded crane

An incorrectly loaded crane falls over.

Death, personal injury, or property damage are the result.

- ▶ Insert the counter ballasts into the counter jib AFTER assembling the jib.

Exception: Insert the necessary counter ballasts of the intermediate ballasting before jib assembly.

■ DANGER! Strong wind, gusts

Wind speeds above authorized speed endanger the stability of the crane during the assembly! You can no longer move loads in a controlled manner. These loads are not statically permissible. Death, personal injury, or property damage are the result.

- ▶ Crane assembly is prohibited at these wind speeds!
- ▶ As the assembly of a crane takes longer, inform yourself about the wind conditions on site; if necessary, postpone the work!

■ DANGER! Larger wind attack areas

Additional advertising boards or other objects increase the area exposed to wind. These additional forces endanger the stability; the crane can fall over. Death, personal injury, or property damage are the result.

- ▶ Only attach additional signs with the approval of the manufacturer.
- ▶ Check the statics.

■ DANGER! Unsuitable components

Unsuitable base, tower, or connecting elements endanger the stability. Death, personal injury, or property damage are the result.

- ▶ Only use tested base elements, such as foundations, cross frames, cross frame elements, or undercarriages.
- ▶ Holes of the tower elements wear out. Tower elements are arranged according to the accuracy of fit of the holes. Use elements with larger deviations in the upper part of the tower. Permissible Deviations: **Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>**.

■ WARNING! Wrong shelves.

Loads will fall or tip if you place them on uneven/unstable surfaces. Death, personal injury, or property damage are the result.

- ▶ Only place loads on level and sufficiently stable surfaces.
- ▶ Use a suitable base on soft ground.

■ CAUTION! Jib bends due to attachment to top boom.

The jib bends to the point of being unusable.

- ▶ Always suspend the jib only by the bottom boom, and lift it horizontally from the assembling trestles.

■ WARNING! Key switch.

Key switches override safety settings. Functions which are not permitted in regular operation are possible.

Death, personal injury, or property damage are the result.

- ▶ Make keys available only to authorized, trained personnel who know and control the risks.

■ **WARNING! ASSEMBLY MODE**

In assembly mode, limit switch and overload limitations are not active. Too heavy a load, and movements with inadmissible radii will cause the crane to fall over.

Death, personal injury, or property damage are the result.

- ▶ Use specially trained personnel who are aware of the particular hazards!
- ▶ Observe the load table for the rope line variant and hoist gear!
- ▶ DO NOT lift loads which exceed the crane's load capacity!
- ▶ Only approach permissible radii!

■ **DANGER! Incorrect calibration, crane falls over**

An incorrectly calibrated load measuring axis endangers the crane stability. This also produces incorrect monitoring of the maximum load and load torque. You can lift loads that are too heavy - the crane falls over.

Death, personal injury, or property damage are the result.

- ▶ Enter the known test load and the correction value carefully and without errors!
- ▶ To determine an unknown test load, use a calibrated crane scale between the load hook and the test load.

■ **CAUTION! Driving positions not limited.**

Do not limit either trolley or load hook travel positions in assembly mode; they will collide with the trolley or ground.

If the trolley and load hook are defective, do NOT operate the crane!

- ▶ Do not move the load hook against the trolley nor on the ground.
- ▶ DO NOT move the trolley to the inner and outer mechanical limits.

■ **DANGER! Activating safety devices.**

Activate safety devices after making adjustments. Otherwise, neither the limit switches nor the overload limitations are active. Movements into impermissible areas will cause the crane to fall over, or lead to collisions with objects.

Death, personal injury, or property damage are the result.

The crane is not ready for operation until:

- ▶ PROGRAMMING and/or ASSEMBLY OPERATION are switched off in the touch panel.
- ▶ all safety devices are adjusted and checked;
- ▶ the slewing gear brakes are ready for operation (brakes unlocked).

2.5.4.2 Foundations

■ **DANGER! Improper foundations, crane falls over**

Improper foundations endanger the crane stability.

Death, personal injury, or property damage are the result.

- ▶ The crane operator's structural engineer determines the foundation loading and its calculation!
- ▶ The building contractor makes the foundation.

- ▶ Wait for curing time before putting load on the foundation!
- ▶ Keep a safety distance of 2 - 3 m between the crane and surrounding objects!
- ▶ The foundation dimensions are determined by the permissible subsoil pressures, the type of subsoil at the construction site, and the foundation load. See **Section 3.5.3!**
- ▶ Check the horizontal alignment before erecting the tower. It may only deviate by max. 1 ‰, i.e. on a measured length of 1 meter, the permissible deviation is 1 mm!

■ **DANGER! Electrical voltage**

Danger from:

- ▶ Voltage differences between conductive parts.
- ▶ Red-hot compensating currents.
- ▶ Lightning.

Death, personal injury, or property damage are the result.

- ▶ Comply with the local regulations for lightning protection when making foundations.

Check them with the local acceptance authorities.

- ▶ Ground the foundation and establish equipotential bonding.

■ **DANGER! Improper foundation, crane falls over**

Improper foundation anchors endanger the crane stability.

Death, personal injury, or property damage are the result.

- ▶ Check the foundation anchors before erecting the tower.
- ▶ Grout foundation anchors until the top edges of the concrete and the foundation anchor plate are in a line. Before, during, and after filling the concrete, ensure that neither foundation anchors nor reinforcement slip.
- ▶ For the calculation of the foundation anchors, we considered concrete with strength grade C 25/30 as per EN 206-1/ DIN 1045-2 for the foundations.
- ▶ The tower attachment points may deviate by a maximum of 1 ‰, i.e. for a measured length of 1 meter, the permissible deviation is 1 mm.

■ **DANGER! Improper rail system, crane falls over**

Improper rail systems endanger the crane stability.

Death, personal injury, or property damage are the result.

- ▶ Execution and calculation are determined by the crane operator's structural engineer!
- ▶ Keep a safety distance of 2 - 3 m between the crane and surrounding objects!
- ▶ The foundation dimensions are determined by the permissible subsoil pressures, the type of subsoil at the construction site, and the foundation load. See **Section 3.5.3!**
- ▶ Lay rails at excavation pits in such a way that the pit slope does not collapse.
- ▶ Check the horizontal alignment of the rail system before erecting the tower.

2.5.4.3 Checking tower and connecting elements

■ **DANGER! Hole tolerances in components exceeded, crane falls over**

Exceeded hole tolerances cause the load limits of the components to be exceeded.

Death, personal injury, or property damage are the result.

- ▶ Holes in tower elements exceeding the specified maximum hole dimensions must NOT be used any more to construct the tower!

2.5.4.4 Equipment-specific

Observe the special instructions depending on the components used.

■ **DANGER! Improper climbing equipment, crane falls over**

Improperly installed climbing equipment endangers the stability.

Death, personal injury, or property damage are the result.

- ▶ Information about climbing equipment: see separate climbing equipment description!
- ▶ Install the climbing equipment parallel to the building; the tower elements must also be installed parallel to the building!
- ▶ For climbing cranes, pay attention to the position of the arresting hooks/climbing plates!

■ **DANGER! Lateral anti-twist devices missing, crane falls over**

If there are no lateral anti-twist devices, the stability of the crane is at risk. The influence by lateral forces shifts the cross frame. Without lateral securing, it slips off the individual foundations – the crane falls over.

Death, personal injury, or property damage are the result.

- ▶ Observe the assembly instructions!
- ▶ At all corners, secure the cross frame on three sides each so that it does not move!

2.5.4.5 Assembly with external climbing equipment

■ **WARNING! Climbing equipment mounted to the tower during operation**

If the climbing equipment remains mounted to the top of the tower during operation, it endangers the crane stability.

Death, personal injury, or property damage are the result.

- ▶ The climbing equipment is only an assembly device. Do NOT leave it on the top of the tower during crane operation! After completion of the assembly, dismount the climbing equipment.
- ▶ Ask the manufacturer for static data for towers with climbing equipment.

2.5.4.6 Pre-assembling the counter jib and assembly

■ **DANGER! Missing stay rods**

Without stay rods, the counter jib will crash down.

Death, personal injury, or property damage are the result.

- ▶ Always assemble the counter jib with guy rods.

■ DANGER! Incorrect assembly sequence, crane falls over

If you do not adhere to the assembly sequence, you endanger the stability.

Death, personal injury, or property damage are the result.

- ▶ Adhere to the sequence of the individual assembly steps!
- ▶ Place the required central ballast before erecting the tower and mounting the counter jib!

■ DANGER! Interrupted assembly, crane falls over

If you interrupt the assembly, you endanger the stability of the crane.

Death, personal injury, or property damage are the result.

- ▶ Carry out the assembly continuously from the work step "Assembling the counter jib" until completion of the work step "Inserting concrete counter ballasts"!

2.5.4.7 Pre-assembling the counter jib and assembly**■ CAUTION! Loose trolley ropes.**

Loose trolley ropes activate the rope failure lock or collide with parts of the jib.

The jib may be damaged.

If the trolley and load hook are defective, do NOT operate the crane!

- ▶ The long trolley rope must always be sufficiently taut:

Check the tension regularly, retighten if necessary.

2.5.4.8 Installing the hoisting rope**■ CAUTION! Risk of collision.**

Do not limit either trolley or load hook travel positions in assembly mode; they will collide with the trolley or ground.

If the trolley and load hook are defective, do NOT operate the crane!

- ▶ Do not move the load hook within the radius or on the ground.
- ▶ DO NOT move the trolley to the inner and outer mechanical limits.

■ DANGER! RESET key switch

Use the RESET key switch to bypass safety functions. Functions which inadmissible in regular operation are now possible.

Death, personal injury, or property damage are the result.

- ▶ Only authorized and trained personnel may operate the RESET key switch as they are aware of the risks.

■ CAUTION! Slack rope.

Keep the load hook in the air when lowering; otherwise the hoisting rope will slacken and not wind up accurately.

This causes damage to the hoisting rope.

- ▶ Carefully lower the load hook and move it to the ground!

2.6 Safety signaling

2.6.1 Explanation

Safety and health-hazard signaling corresponds to determined object, activity or situation-related signals providing an indication or provision relative to safety or health matters. That signaling is materialized, according to circumstances, by a **panel**, a **color**, an **audio** or **luminous signal**.

Safety signaling can be broken down into 5 categories, each identified by a color code.

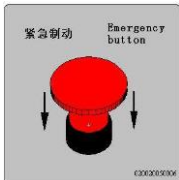
- Prohibition (*red*)
- Warning (*yellow or orange-hue yellow*)
- Mandatory (*blue*)
- Rescue and first-aid (*green*)
- Fire-fighting material or equipment (*red*)

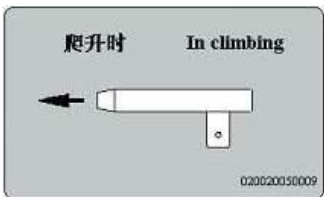
2.6.2 Terminology

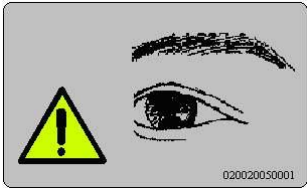
- Panel: signal providing a given indication via the combining of a geometrical shape and certain colors with a symbol or a pictogram.
 - Prohibition panel: prohibits behavior liable to generate running of a risk or provoking danger.
 - Warning panel: warns of a risk or of danger.
 - Mandatory panel: prescribes a given behavior to be adopted.
 - Rescue and first-aid panel: provides indications relative to emergency exits or to rescue and first-aid resources available.
 - Fire-fighting panel: provides indications relative to the location of fire-fighting resources and evacuation in the case of fire.
- Additional panel: panel used conjointly with another panel and providing complementary indications.
- Symbol or pictogram: image describing a situation or prescribing a given behavior to be adopted, and which is employed on a panel or a luminous surface.
 - Luminous signal: signal emitted by a device composed of transparent or translucent material, internally or back-lighted, in a way it stands out itself as a luminous surface.
 - Audio signal: a coded audible signal emitted and broadcast by an ad hoc device, without the use of a human or synthesized voice.

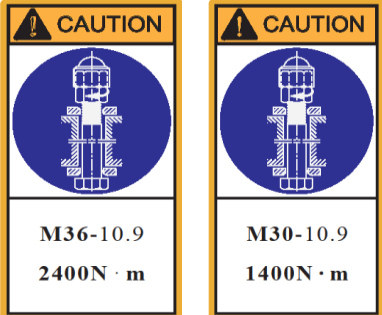
2.6.3 Signaling panels

The signaling panels below are general signals for all the crane towers. The specific panels on your tower crane may be less or more according to your special configuration.

Drawing	Instruction
	WARNING: Live parts! Electrical installation, connection work and maintenance must be done only by authorized, properly qualified personnel.
	Don't stand under the working radius.
	Prohibit climbing!
	Danger of rolling!
	Danger of falling down! Wear and use a safety harness!
	Emergent stop

Drawing	Instruction
	Carefully read this handbook before handling the machine!
	The tower crane needs to be able to slew freely when it is out of service
	Very hot, do not touch!
	Danger of crushing!
	Insert pins while the crane climbing!

Drawing	Instruction
	Keep watching!
	WARNING: floating loads! Wear safety helmet!
	Check ropes
	Lubricate!
	Check metal structures!
	Check brakes for clearance!
	Keep safety devices workable!

Drawing	Instruction
 1.调整制动方矩。 2.调整制动瓦间隙。 3.调整瓦块上下间隙均匀。 4.调整两瓦的间隙均匀。 1.Adjusting the braking moment. 2.Adjusting the clearances of the brake disc and braking clamps. 3.Adjusting the clearances of one braking clamp and brake disc in uniform. 4.Adjusting the clearances of the braking clamps and the brake disc in uniform.	Adjust the brakes
 更换钢丝绳后必须重新调整高度限位器。 It is necessary to adjust the height limiter again after changing wire rope.	Adjust the height limiter!
 CAUTION M36-10.9 2400N · m CAUTION M30-10.9 1400N · m	High strength connection bolt of M36 High strength connection bolt of M30
 180kg (人+人+车)	Maximum load on maintenance cage
	Always close the hatches!
	Prohibit standing!
 注意安全 Caution danger	Caution!

Drawing	Instruction
	Tie safety belt!

2.6.4 Audio and luminous signals

A. Audio signals

The following dangers are signaled by automatic activation of an audio alarm:

- Crane start-up: short tone.
- Activation of MSWL (maximum safe working load) cut-out or moment cut-out: continuous tone.
- Crane traveling mode: continuous dual tone during the complete duration of movement.
- Specific danger is signaled by voluntary action on the audio alarm in accordance with code defined by local regulations or by the crane manager, such as for example: moving of loads above persons, specific situations.
- Acquire knowledge of the tones and duration corresponding to each signal.

B. Luminous signals

According to the instructions or regulations on crane utilization site, luminous signals may be used to indicate specific danger:

- Operating wind speed pre-alarm (adjustable): flashing orange light.
- Pre-alarm limit: 90% of MSWL or MSWL moment:
 - GMA: flashing orange light
 - GME: orange light in control station
- Working area limiter not operating or neutralized: flashing red light.

C. Associated audio and luminous signals

According to the instructions or regulations on crane utilization site, audio signals associated to luminous signals may be used to indicate specific danger:

- Maximum operating wind speed (adjustable): 2-tone signal with flashing orange and red lights.
- (GMA) Pre-alarm limit: 95% of MSWL or MSWL moment: continuous-tone signal with flashing orange light.
- (GMA) Activation of the MSWL limiter or MSWL moment limiter: continuous signal plus 2-tone signal with flashing orange and red lights.

D. Location of safety signaling:

Positioning on the crane and references of luminous or audio panels and devices are provided in the **Chapter 7 < SPARE PARTS >**.

2.6.5 Safety controls

The control console and the maintenance areas at winch proximity (in the case where the control console is not portable) are equipped with a mechanically-lockable red emergency stop button.

The storm wind reference speeds are determined according to the FEM 1.004 / Edition 07/2000 standard.



Pressing one of those buttons generates immediate interruption of all movements.



The emergency stop button must be used only in the case of danger and not for interrupting movements.

2.7 Storm wind speed-out of service**2.7.1 General Notes**

The storm wind reference speeds are determined according to the FEM 1.004 / Edition 07/2000 standard.

2.7.2 Speed table

Height	Wind speed	Dynamic pressure
Height 0–20 m above the ground	130 km/h (36 m/s)	800N/m ²
Height 20–100 m above the ground	150 km/h (42 m/s)	1100 N/m ²
Height higher than 100 m above the ground	165 km/h (46 m/s)	1300 N/m ²

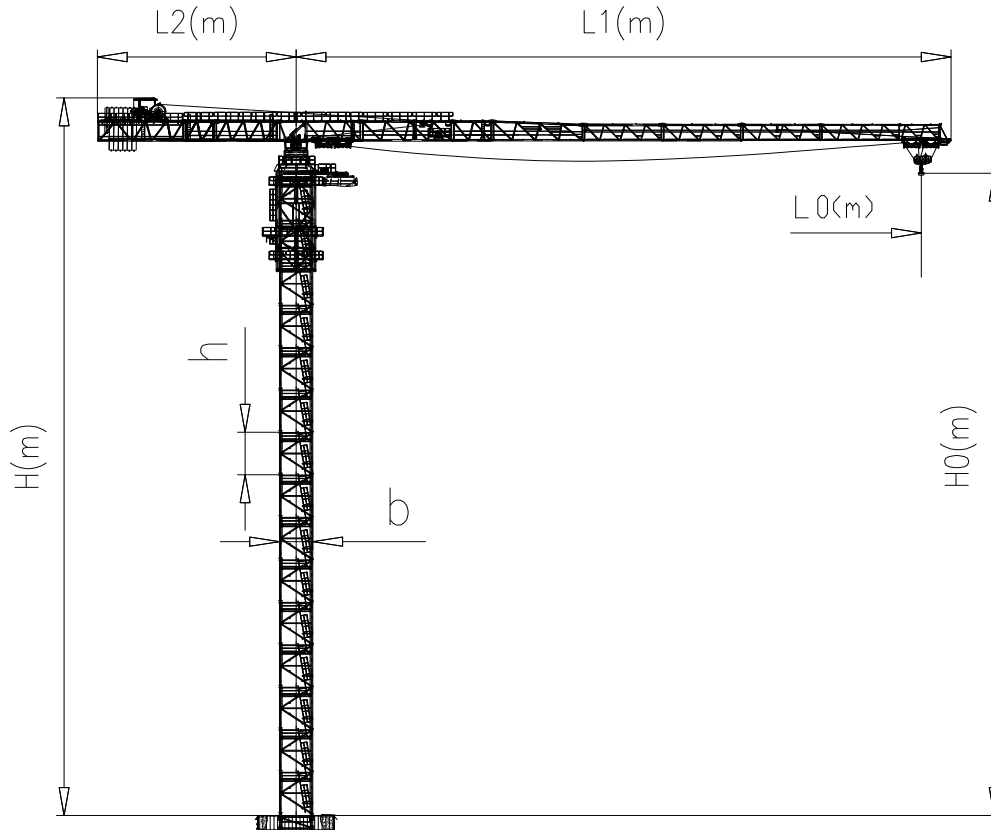


If the load surface is bigger than 1m²/t, the wind speed must be limited. Consult us for details.

3 TECHNICAL DATA OF CRANE AND SITE

3.1 Overall dimensions

The dimensions of the tower crane are shown in the table below:



L0	L1	L2	Maximum working height H0				Maximum tower crane height H	b	h
			Free-standing			With attachments			
			Outrigger stationary	Stationary chassis	Travelling chassis				
80	82.7	25.1	86	75.4	77.3	296.9	H0+11.4	4.2	5.7
75	77.7								
70	72.7								
65	67.7								
60	62.7	21.3							
55	57.7								
50	52.7								
45	47.7								
40	42.7	17.1							
35	37.7								
30	32.7								

L0: Maximum trolley range **L1:** Jib side length **L2:** Counter jib side length

b: Tower section width **h:** Tower section height **Unit: m**

3.2 Technical characteristics

3.2.1 Load charts

3.2.1.1 Load chart of jib 80m

Radius(m)	5	20	21.87	25	28	30	32	35	38
2 falls(t)	32.00								
4 falls(t)	64.00			54.71	47.83	44.05	40.75	36.54	33.02
Radius(m)	40	42.28	45	48	50	52	55	58	60
2 falls(t)	32.00		29.79	27.65	26.38	25.20	23.60	22.17	21.29
4 falls(t)	30.98	28.89	26.68	24.55	23.27	22.09	20.49	19.06	18.19
Radius(m)	62	65	68	70	72	75	78	80	
2 falls(t)	20.48	19.35	18.32	17.69	17.09	16.25	15.48	15.00	
4 falls(t)	17.37	16.24	15.22	14.58	13.98	13.15	12.37	11.89	

3.2.1.2 Load chart of jib 75m

Radius(m)	5	20	21.92	25	28	30	32	35	38
2 falls(t)	32.00								
4 falls(t)	64.00			54.85	47.96	44.16	40.86	36.64	33.12
Radius(m)	40	42.37	45	48	50	52	55	58	60
2 falls(t)	32.00		29.87	27.73	26.45	25.27	23.66	22.23	21.35
4 falls(t)	31.07	28.90	26.76	24.62	23.34	22.16	20.56	19.12	18.25
Radius(m)	62	65	68	70	72	75			
2 falls(t)	20.53	19.40	18.38	17.71	17.14	16.30			
4 falls(t)	17.43	16.30	15.27	14.63	14.03	13.19			

3.2.1.3 Load chart of jib 70m

Radius(m)	5	20	21.98	25	28	30	32	35	38
2 falls(t)	32.00								
4 falls(t)	64.00			55.03	48.12	44.31	41.00	36.77	33.23
Radius(m)	40	42.49	45	48	50	52	55	58	60
2 falls(t)	32.00		29.96	27.82	26.53	25.35	23.74	22.30	21.42
4 falls(t)	31.17	28.89	26.86	24.71	23.43	22.24	20.63	19.19	18.32
Radius(m)	62	65	68	70					
2 falls(t)	20.60	19.47	18.44	17.80					
4 falls(t)	17.50	16.36	15.33	14.69					

3.2.1.4 Load chart of jib 65m

Radius(m)	5	20	22.01	25	28	30	32	35	38
2 falls(t)	32.00								
4 falls(t)	64.00			55.11	48.19	44.38	41.06	36.83	33.28
Radius(m)	40	42.54	45	48	50	52	55	58	60
2 falls(t)	32.00		30.00	27.86	26.57	25.39	23.78	22.34	21.46
4 falls(t)	31.22	28.89	26.90	24.75	23.47	22.28	20.67	19.23	18.35
Radius(m)	62	65							
2 falls(t)	20.64	19.50							
4 falls(t)	17.53	16.39							

3.2.1.5 Load chart of jib 60m

Radius(m)	5	20	22.04	25	28	30	32	35	38
2 falls(t)	32.00								
4 falls(t)	64.00			55.22	48.28	44.47	41.15	36.90	33.35
Radius(m)	40	42.62	45	48	50	52	55	58	60
2 falls(t)	32.00		30.07	27.91	26.63	25.44	23.82	22.38	21.50
4 falls(t)	31.29	28.89	26.96	24.81	23.52	22.33	20.72	19.27	18.39

3.2.1.6 Load chart of jib 55m

Radius(m)	5	20	22.10	25	28	30	32	35	38
2 falls(t)	32.00								
4 falls(t)	64.00			55.39	48.44	44.61	41.28	37.02	33.46
Radius(m)	40	42.73	45	48	50	52	55		
2 falls(t)	32.00		30.16	28.00	26.71	26.10	23.90		
4 falls(t)	31.39	28.89	27.05	24.89	23.60	22.41	20.79		

3.2.1.7 Load chart of jib 50m

Radius(m)	5	20	22.17	25	28	30	32	35	38
2 falls(t)	32.00								
4 falls(t)	64.00			55.57	48.60	44.76	41.42	37.15	33.58
Radius(m)	40	42.86	45	48	50				
2 falls(t)	32.00		30.26	28.10	26.80				
4 falls(t)	31.51	28.89	27.15	24.99	23.69				

3.2.1.8 Load chart of jib 45m

Radius(m)	5	20	22.19	25	28	30	32	35	38
2 falls(t)	32.00								
4 falls(t)	64.00			55.65	48.67	44.82	41.48	37.20	33.63
Radius(m)	40	42.90	45						
2 falls(t)	32.00		30.30						
4 falls(t)	31.55	28.89	27.19						

3.2.1.9 Load chart of jib 40m

Radius(m)	5	20	22.22	25	28	30	32	35	38	40
2 falls(t)	32.00									
4 falls(t)	64.00			55.72	48.73	44.89	41.54	37.26	33.68	31.60

3.2.1.10 Load chart of jib 35m

Radius(m)	5	20	22.24	25	28	30	32	35
2 falls(t)	32.00							
4 falls(t)	64.00			55.78	48.79	44.93	41.58	37.30

3.2.1.11 Load chart of jib 30m

Radius(m)	5	20	22.24	25	28	30
2 falls(t)	32.00					
4 falls(t)	64.00			55.80	48.80	44.95

3.2.2 Characteristics of the crane

3.2.2.1 The overall characteristics

Tower crane working grade		A3					
Mechanisms working grade		Hoisting mechanism		Slewing mechanism		Trolley mechanism	
		M4		M5		M4	
Rated hoisting moment (kN·m)		12000					
Maximum hoisting moment (kN·m)		13950					
Maximum tower height (m)		Free-standing				With attachments	
		Outrigger stationary	Stationary chassis	Travelling chassis			
		86.0	81.1	83.0		296.9	
Working radius (m)		Minimum			Maximum		
		5.0			80		
Jib length (m)		80	75	70	65	60	55
Counter ballast weight (t)		72.5	69.0	66.5	62.5	75.0	75.0
Counter jib length (m)		25.1				21.3	
Jib length (m)		50	45	40	35	30	/
Counter ballast weight (t)		66.5	66.5	81.5	79.0	72.5	/
Counter jib length (m)		21.3		17.1			/
Maximum load (t)		64					
Power Supply		~380 V (±10%), 50Hz					
Hoisting speed	Fall	2			4		
	Load (t)	32	16	8	64	32	16
	Speed (m/min)	30.5	61.0	85.0	15.3	30.5	42.5
Slewing speed (r/min)		0~0.6					
Trolley speed (m/min)		0~50					
Travelling speed (m/min)		0~15					
Total power (kW)		274 (without climbing mechanism, travelling mechanism)					

3.2.2.2 Hoisting mechanism characteristics

	Model		H200FL160-1150D
	Maximum traction (N)		18×10^4
Rope	Specification		GS-K34-Φ30-1960
	Maximum line speed (m/min)		170
Drum	Rope roll layers		8
	Maximum capacity (m)		1150/8 层
Motor	Model		TCA355L-8
	Power (kW)		200
Reducer	Model		MB3H150HB45BT
	Reduction ratio		42.621
Coupling	Model		MLL12-I-500 $\frac{ZA110 \times 167(25)}{JA100 \times 167(28)}$
Brake	Model		YWZ501-500/300- II A-WC.RL.HL
	Brake moment (N·m)		170

3.2.2.3 Slewing mechanism characteristics

	Model		S185CA-350.275CD20/13B S185CN-350.275CD20/13B
Motor	Model		YTRVF180L1-4F1/D YTRVF180L1-4F2/D/BM1
	Power (kW)		18.5
Reducer	Model		XX5-350.275CD-20/13
	Reduction ratio		275
	Pinion	Teeth [z]	13
		Module [m]	20

3.2.2.4 Trolley mechanism characteristics

	Model	T185FC80
	Maximum traction (N)	54000
	Trolley travelling range (m)	80
Rope	Specification	6×29Fi+IWR-16-1960-ZS
	Line speed (m/min)	0~50
Motor	Model	YVFE200L1-6B5
	Power (kW)	18.5
Reducer	Model	XX5-180.85
	Ratio	86.246

3.2.2.5 Climbing mechanism characteristics

Pump station	Model	BZ30-33.5
	Flux (l·min)	47
	Maximum pressure (MPa)	33.5
	Oil tank capacity (L)	380
Motor	Model	YE3-200L-4-B35
	Power (kW)	30
Climbing cylinder	Model	YG280/200-2250/2850-31.5
	Cylinder diameter (mm)	280
	Rod diameter (mm)	200
	Installing distance (mm)	2250
	Travelling distance (mm)	2850
	Maximum jacking force (t)	397
	Jacking speed (m/min)	0.38

3.3 Mast composition

3.3.1 Outrigger stationary tower crane

Working height (m)	Outrigger	Base tower section	Tower section
	D1100.15A	X42Rb	X42D
17.6	1	1	2
23.3	1	1	3
29.0	1	1	4
34.7	1	1	5
40.4	1	1	6
46.1	1	1	7
51.8	1	1	8
57.5	1	1	9
63.2	1	1	10
68.9	1	1	11
74.6	1	1	12
80.3	1	1	13
86.0	1	1	14

3.3.2 Stationary/Travelling chassis tower crane

Working height (m)		Chassis	Tower section
Stationary chassis	Travelling chassis	D1100.14B	X42D
24.1	26.0	1	2
29.8	31.7	1	3
35.5	37.4	1	4
41.2	43.1	1	5
46.9	48.8	1	6
52.6	54.5	1	7
58.3	60.2	1	8
64.0	65.9	1	9
69.7	71.6	1	10
75.4	77.3	1	11

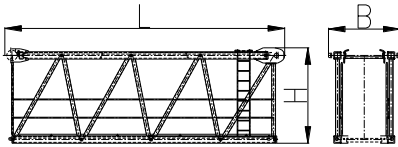
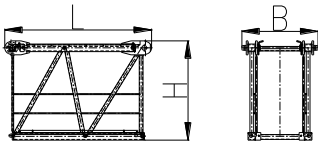
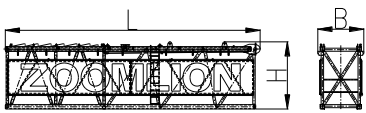
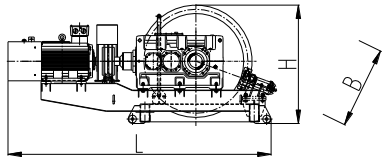
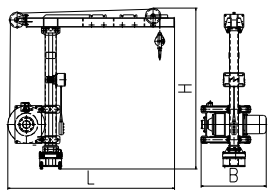
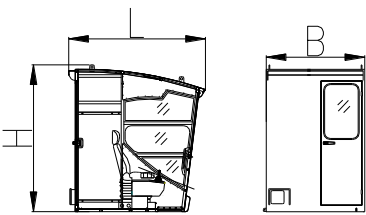
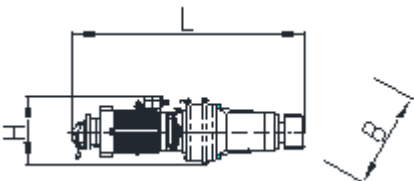
3.4 Dimensions and weights of parts for transportation

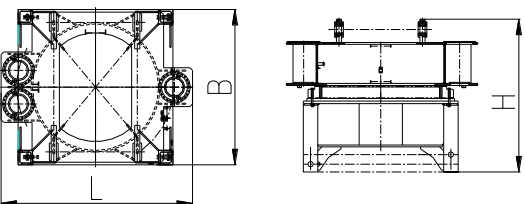
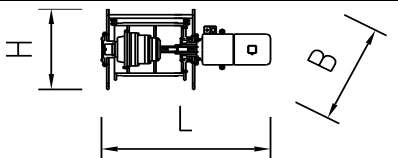
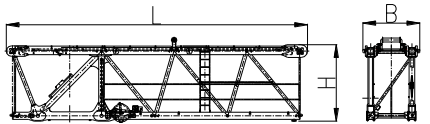
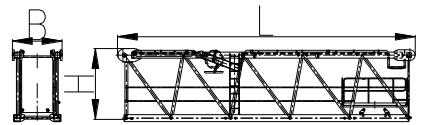
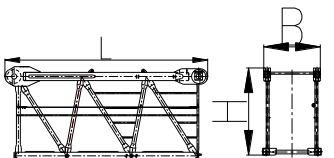
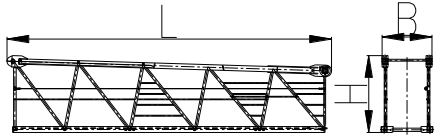
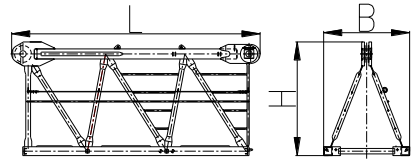
3.4.1 Matters need attentions of transportation

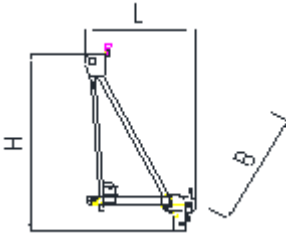
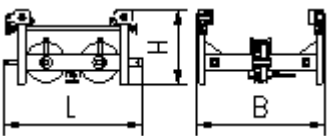
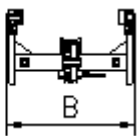
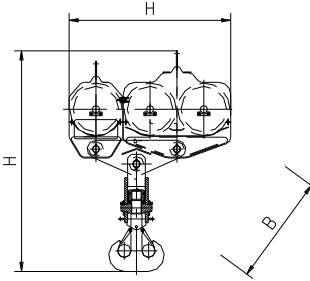
The components of tower crane have been taken apart into many delivery units in order to facilitate the packing and adapting to the means of transportation.

- 1) All components must be well securely fixed during the means of transportation.
- 2) Light delivery units must be put on the heavier ones.
- 3) In order to prevent damage to the painted surface, the cushions or wooden segregation boards should be set between the delivery sets.
- 4) It must be ensured that no parts of tower crane are in direct contact with the ground when unloading, so as to prevent sand and oil etc., into the holes of the structure.
- 5) Do not use inappropriate means of transportation to move the parts of tower crane, such as bulldozers or elevators. The weight and dimension of all parts of ZOOMLION tower crane are described in detail in later chapters.
- 6) Before transport the tower crane, to make sure the safe transportation of all the auxiliary equipment.
- 7) Check whether the transportation ties are tight or not.
- 8) Check the strapping of cargos for transportation.
- 9) When the carrier vehicle drives on the public streets, please obey the relevant laws.
- 10) When the carrier vehicle passes the underground tunnel, bridge and tunnel, please pay attention to have enough space.

3.4.2 Slewing parts

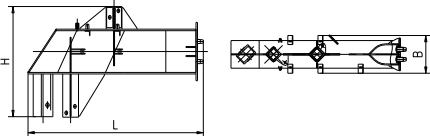
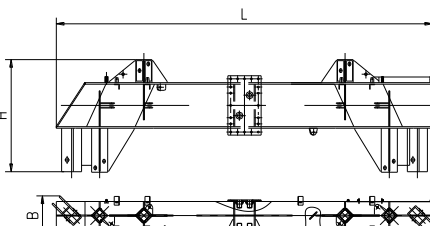
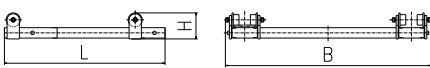
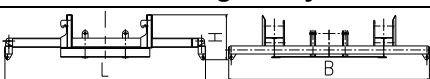
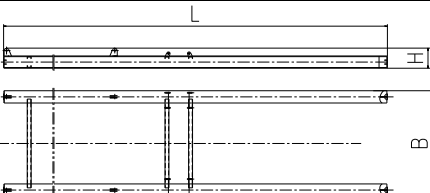
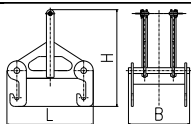
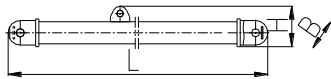
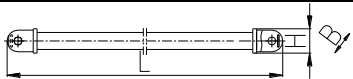
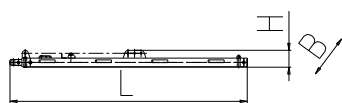
No.	Sketch / Designation	L(m)	B(m)	H(m)	G(t)	Qty
1	 Front counter-jib	8.46	1.85	2.88	7.5	1
2	 Middle counter-jib	3.94	1.85	2.85	4.2	1
3	 Rear Counter-jib	11.07	1.98	2.95	10.2	1
4	 Hoisting mechanism (with rope)	4.71	2.88	2.12	15.3	1
5	 Derrick	2.98	1.16	2.85	1.2	1
6	 Cabin	2.08	1.5	2.24	0.8	1
7	 Slewing mechanism	2.08	0.62	0.62	1.0	3

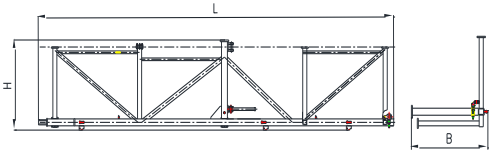
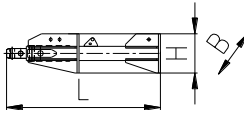
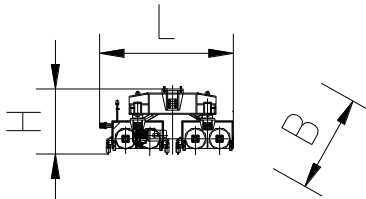
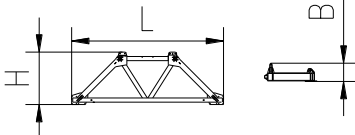
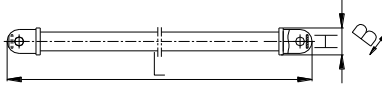
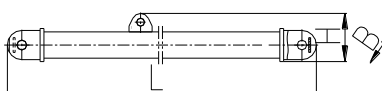
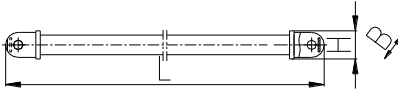
No.	Sketch / Designation		L(m)	B(m)	H(m)	G(t)	Qty
8	 Slewing unit (Including turntable, slewing ring, slewing support)		3.8	3.0	2.98	21.2	1
9	 Trolley mechanism		2.04	0.98	1.05	1.7	1
10	 Jib I		11.0	2.26	3.94	13.3	1
11	 Jib II		12.00	1.83	3.07	10.6	1
12	 Jib III		5.14	1.90	2.84	4.2	1
13	 Jib IV		11.96	1.90	2.84	7.2	1
14	Jib V		10.48	1.90	2.37	4.6	1
15	Jib VI		10.48	1.90	2.37	3.6	1
16	Jib VII		10.39	1.90	2.56	2.6	1
17	Jib VIII		10.29	1.9	2.23	2.0	1
18	Jib IX		5.24	1.9	2.20	0.8	1

No.	Sketch / Designation		L(m)	B(m)	H(m)	G(t)	Qty
19	 Jib end		1.52	1.9	2.86	0.5	1
20	Main trolley		2.5	2.28	1.5	1.1	1
	Auxiliary trolley		2.5	2.28	1.5	0.9	1
21	 Hook		2.2	0.4	3.0	2.4	1

☆Tolerance on the weight: $\pm 5\%$.

3.4.3 Mast parts

No.	Sketch / Designation		L(m)	B(m)	H(m)	G(t)	Qty
1	Transition section	 Half beam	3.5	0.7	2.2	2.5	2
		 Whole beam	7.4	0.8	2.2	5.2	1
2	Mounting device	 Mounting trolley	1.83	2.34	0.30	0.4	1
		 Lifting frame	3.49	3.49	0.79	0.7	1
		 Mounting beam	7.80	2.15	0.41	1.2	1
		 Mounting hook	0.91	0.64	1.00	0.2	1
3	Mast section	 Incline web member	1.61	0.17	0.25	0.2	120 /96
		 Incline web member	1.72	0.15	0.15	0.1	120 /96
		 Main chord	6	0.51	0.44	1.2	60 /48

No.	Sketch / Designation		L(m)	B(m)	H(m)	G(t)	Qty
4	 Climbing equipment		13.3	2.86	2.87	5.9	4
5	 Outrigger		2.34	0.60	0.60	0.7	4
6	Travelling bogie I		4.1	1.1	2.0	9.2	2
7	Travelling bogie II						2
Chassis							
8	Piece beam		11.0	1.4	3.8	11.1	2
9	Straight strut		3.5	0.5	0.3	0.3	2
10	Incline strut		4.8	0.4	0.3	0.4	1
11	Strut		10.4	0.5	0.4	2.4	4
12	Incline web member		1.61	0.17	0.25	0.2	20
13	Straight web member		1.72	0.15	0.15	0.1	20
14	Main chord I		6	0.51	0.44	1.2	4
15	Main chord II		6	0.51	0.51	1.3	4

☆Tolerance on the weight: $\pm 5\%$.

3.5 Data sheet

3.5.1 Hoisting rope

DATA SHEET – HOISTING ROPE

Rope identification	1090101583 (GS-K34-30-1960)
Maximum load	170 kN
Minimum breaking load	760 kN
Construction	35-k7
Number of external wires	112
Core:	Steel
Rope diameter	30 mm
Strength of wire	1960 N/mm ²
Stranding: ZS (Right-hand regular lay) ZZ (Right-hand langs lay)	ZZ
Twist coefficient	0.021
Weight per meter	4.59 kg/m

3.5.2 Trolley rope

DATA SHEET – TROLLEY ROPE

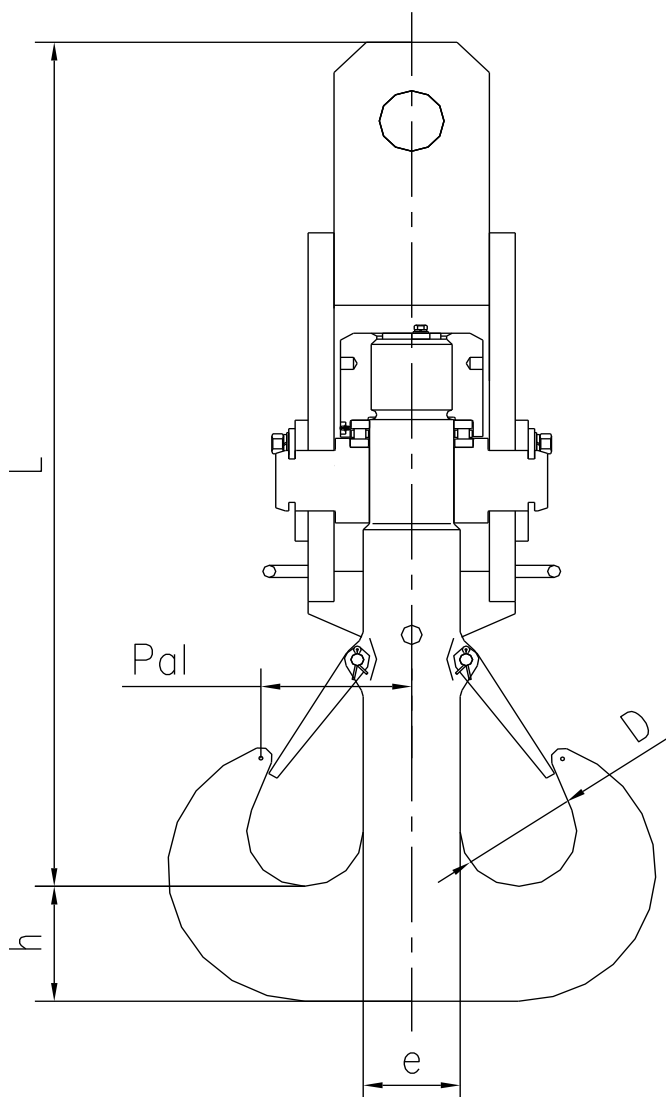
Rope identification	1090101542 (6×29Fi+IWR-16-1960-ZS)
Maximum load	54 kN
Minimum breaking load	179 kN
Construction	6×29
Number of external wires	174
Core:	Steel
Rope diameter	16
Strength of wire	1960 N/mm ²
Stranding: ZS (Right-hand regular lay) ZZ (Right-hand lang's lay)	ZS
Weight per meter	1.18 kg/m



Hoisting rope is configured as rotary resistance rope. In addition, the following requirements must be met: (D is the theoretical diameter of the rope)

- For the hoisting rope and the trolley rope, the diameter of any section is between 1.02d and 1.04d. The noncircular error is within 0.03d.
- Anti-torsion performance of hoisting rope is not more than 360°.
- The lateral pressure stability of the hoisting rope is not more than 0.01d.
- The diameter shrinkage of the hoisting rope is not more than 0.01d.

3.5.3 Load hook



Hook identification	000209620A0404000
Length (L)	1396 mm
Nominal diameter (D)	180 mm
Weight	534 kg
Greasing	Yes
Passage with hook safety path (Pal)	233 mm
Dimension (h)	190 mm
Dimension (e)	150 mm

3.6 Counter ballast

3.6.1 General notes

The Counter ballast comprises several reinforced concrete blocks. Their combination allows the different weights to be obtained, which are proper to each jib length used. There are three types: The **PHZ12500E**, **PHZ10000K**, **PHZ6500F** blocks, weight 12500 kg, 10000 kg and 6500 kg; they are directly placed on the rear counter-jib.

3.6.2 Configuration

Jib length	(Jib side → Counter jib side) 7 counter ballast slots (t)							Total
	The first	The rest						
80m	12.5	12.5	12.5	12.5	12.5	10.0	/	72.5
75m	12.5	12.5	12.5	12.5	12.5	6.5	/	69.0
70m	12.5	12.5	12.5	12.5	10.0	6.5	/	66.5
65m	12.5	12.5	12.5	12.5	12.5	/	/	62.5
60m	12.5	12.5	12.5	12.5	12.5	12.5	/	75.0
55m	12.5	12.5	12.5	12.5	12.5	12.5	/	75.0
50m	12.5	12.5	12.5	12.5	10.0	6.5	/	66.5
45m	12.5	12.5	12.5	12.5	10.0	6.5	/	66.5
40m	12.5	12.5	12.5	12.5	12.5	12.5	6.5	81.5
35m	12.5	12.5	12.5	12.5	12.5	10.0	6.5	79.0
30m	12.5	12.5	12.5	12.5	12.5	10.0	/	72.5

3.6.3 Assembly drawing and spare part list of counter ballasts

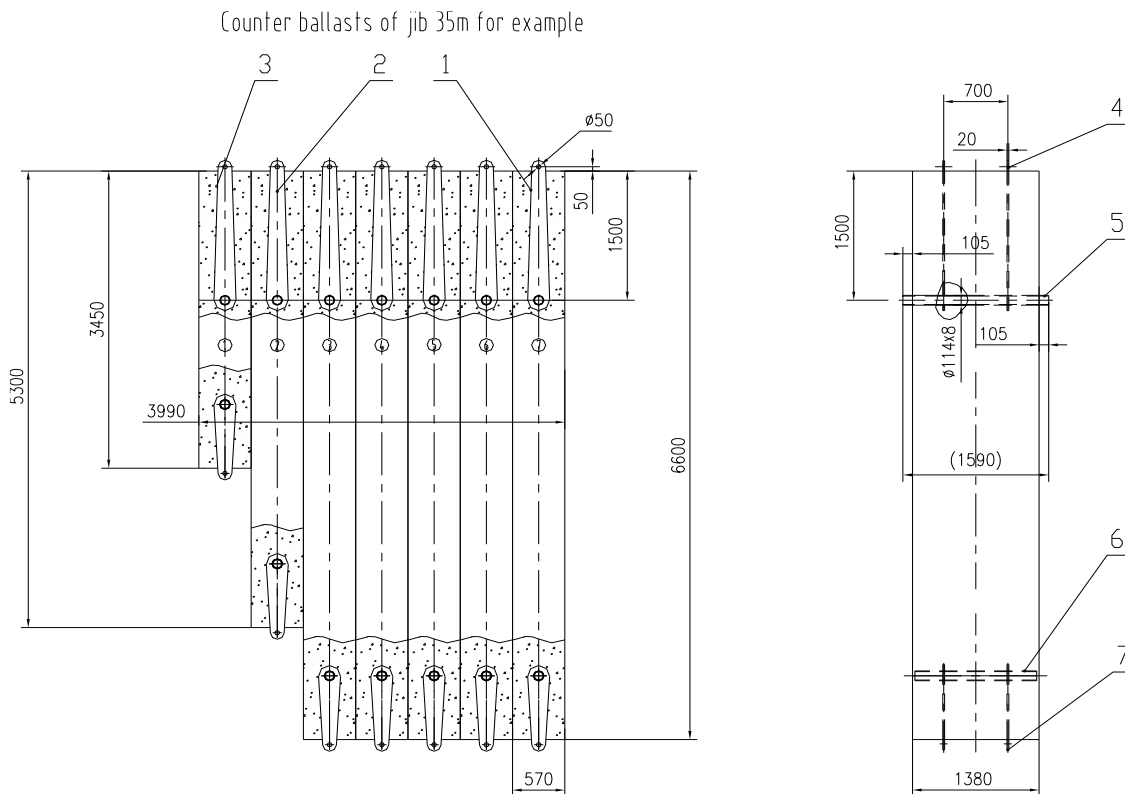
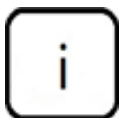


Fig. 3-1 Assembly drawing of **R1300-64-PHZA (000274099BT010000)**

Table 3-1 Spare part list of counter ballasts

No.	Order No.	Code	Designation	Specification	Qty	Material
1	000209915G0125000	PHZ12500E	Counter ballast 12.5t		6	Reinforced Concrete
2	000209915F0100000	PHZ10000K	Counter ballast 10t		1	Reinforced Concrete
3	000209915F0065000	PHZ6500F	Counter ballast 6.5t		1	Reinforced Concrete
4	000251099AT100100		Lifting lug	t20	16	Q345B
5	000251099AT100200		Steel pipe		8	Weldment
6	000274099DT010010		Steel pipe	Φ114×8-1328	8	Q235B
7	000208886A0003822		Lifting lug II		16	Q345B

☆ Generally, the counter ballast pins and steel pipes are provided by ZOOMLION, the counter ballasts are made by users.



Paint the counter ballasts to be chequered with yellow and black for warning.

3.6.4 Fabrication

The ballast blocks must be carried out according to the following drawings. It is recommended to observe the outer dimensions of the blocks and the functional dimensions, especially the position of the suspension holes, the position of the raising device and its dimensions.

The reinforcement of the blocks including the raising device will be determined and carried out by the crane user to avoid the crumbling and dislocation of the blocks when handling and during crane work.

3.6.4.1 Technical requirements

- 1) Weld by welding rod E4316;
- 2) Put lifting hook and steel pipe in the rebar cage before rolling the rebars;
- 3) Weld each pair of the lifting lug and Part 5, lifting lug and Part 9, steel pipe and Part 4, Part 6 and Part 8 together by spot welding; Fit the Part 4, 5 to the outside frame close, weld them in the angle steel, the welding height is 3mm, so to fix the lifting lug and steel pipe;
- 4) After the spot welding of the rebar net, place it in the outside frame (assembly of Part 1, 2, 3), then weld the outside frame firmly, finally weld the rebar net to the outside frame by short rebars;
- 5) Ensure the overall dimensions are 570×1380 when welding the outside frame; when pouring the concrete, the concrete must be poured fully, don't pour it beyond the angle steel edges of the outside frame;
- 6) Weigh the counter ballast (including lifting lug and steel pipe) after pouring and the allowable weight error is 1%;
- 7) Mark the weight at two side of the top of each finished counter ballast;
- 8) The concrete strength is over C25;
- 9) All parts of the drawings are provided by user. (or contact us for providing)

3.6.4.2 Steel

Es: Longitudinal modulus of elasticity of steel: 200000 N/mm² i.e. 200000MPa

Type 1: Reinforcement with high adherence obtained by hot-rolling of natural high-carbon steel.

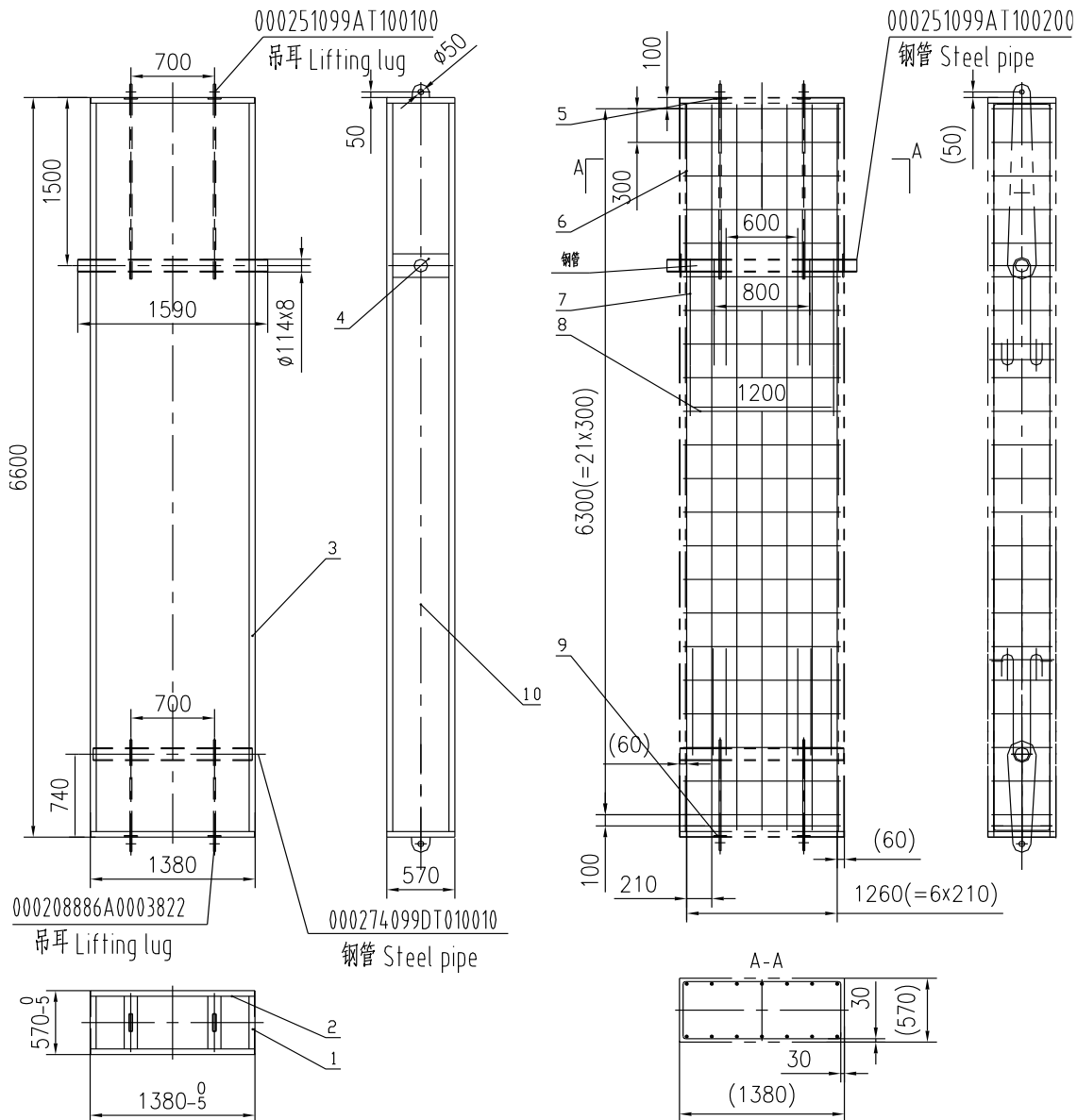
Quality: Fe E 40 i.e. $f_e=400\text{MPa}$



If the above rules are not applicable, refer to the rules applied in the user country.

3.6.4.3 Preparing the block PHZ12500E

- The concrete is about **4.865 m³** in total (in density **2400kg/ m³**).



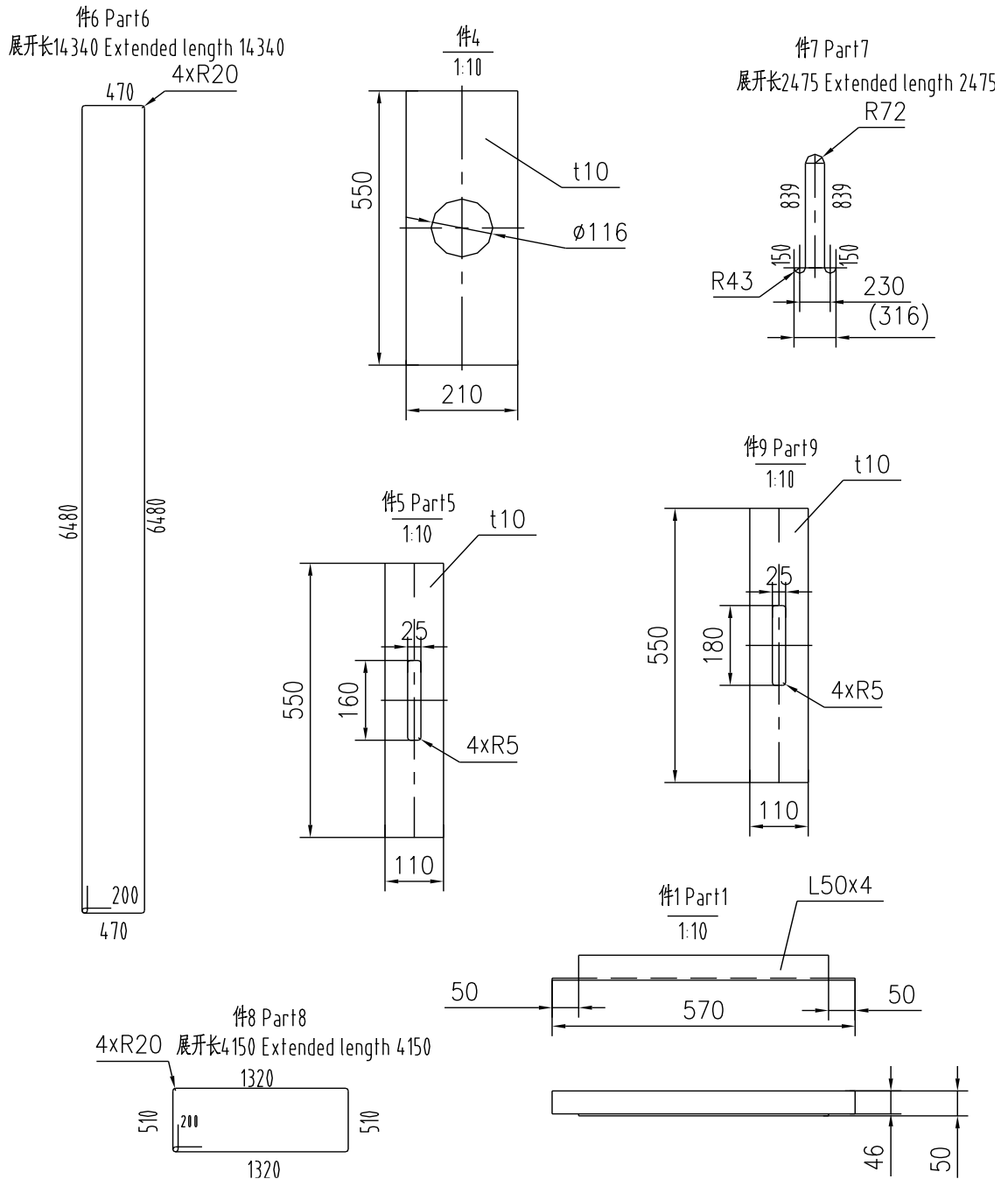


Fig. 3-2 Counter ballast PHZ12500E

Table 3-2 Spare part list of PHZ12500E

No.	Designation	Specification	Qty	Material	Remarks
1	Angle steel	L50×4	4	Q235B	
2	Angle steel	L50×4-1372	4	Q235B	
3	Angle steel	L50×4-6500	4	Q235B	
4	Plate	t10	2	Q235B	
5	Plate	t10	2	Q235B	
6	Rebar	Φ25	7	HRB335	
7	Rebar	Φ25	12	HRB335	
8	Rebar	Φ16	23	HPB300	
9	Plate	t10	2	Q235B	
10	Concrete		1	C25	

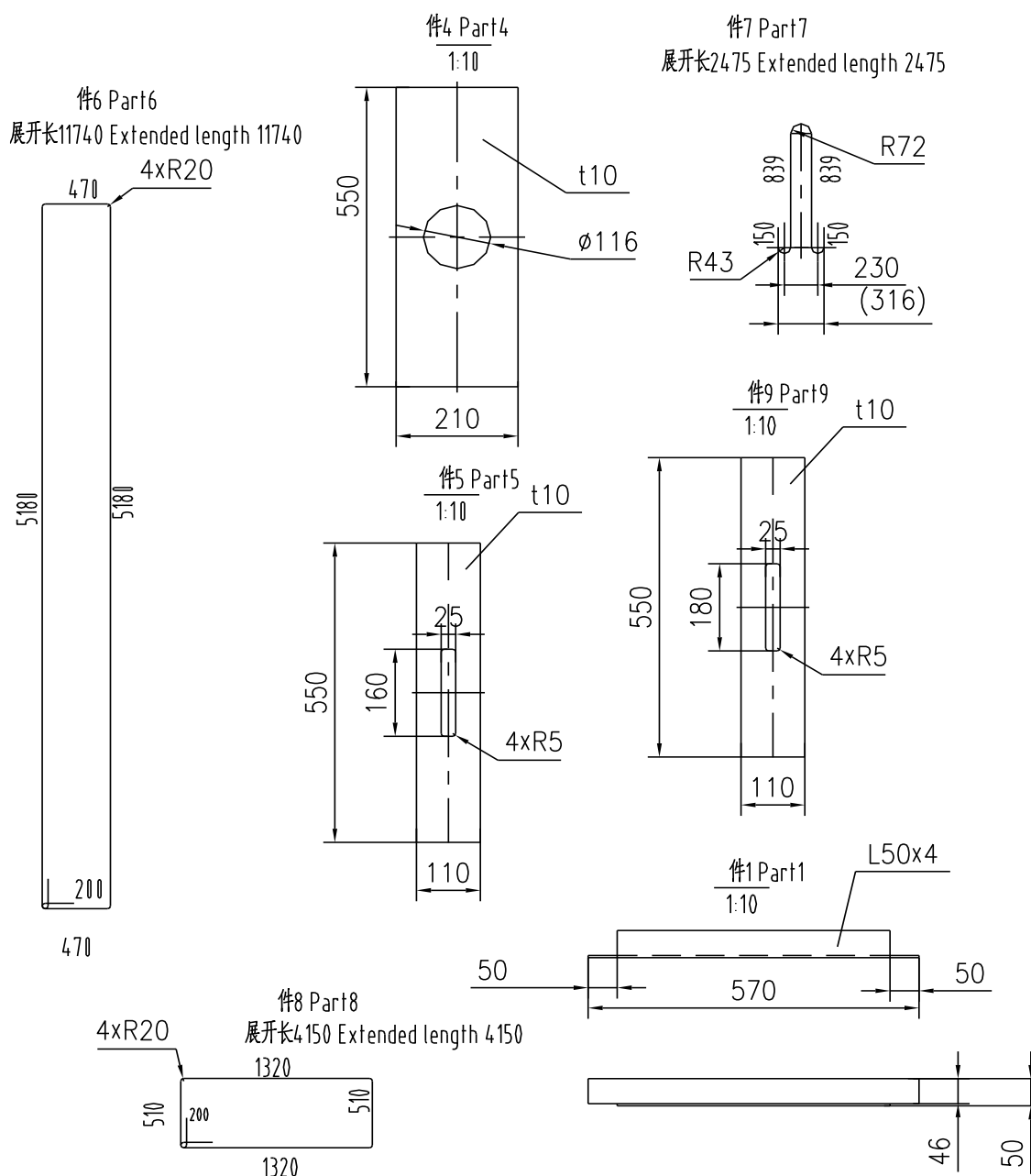


Fig. 3-3 Counter ballast PHZ10000K

Table 3-3 Spare part list of PHZ10000K

No.	Designation	Specification	Qty	Material	Remarks
1	Angle steel	L50×4	4	Q235B	
2	Angle steel	L50×4-1372	4	Q235B	
3	Angle steel	L50×4-5200	4	Q235B	
4	Plate	t10	2	Q235B	
5	Plate	t10	2	Q235B	
6	Rebar	Φ25	7	HRB335	
7	Rebar	Φ25	6	HRB335	
8	Rebar	Φ16	18	HPB300	
9	Plate	t10	2	Q235B	
10	Concrete		1	C25	

3.6.4.5 Preparing the block PHZ6500F

- The concrete is about **2.444 m³** in total (in density **2400kg/ m³**).

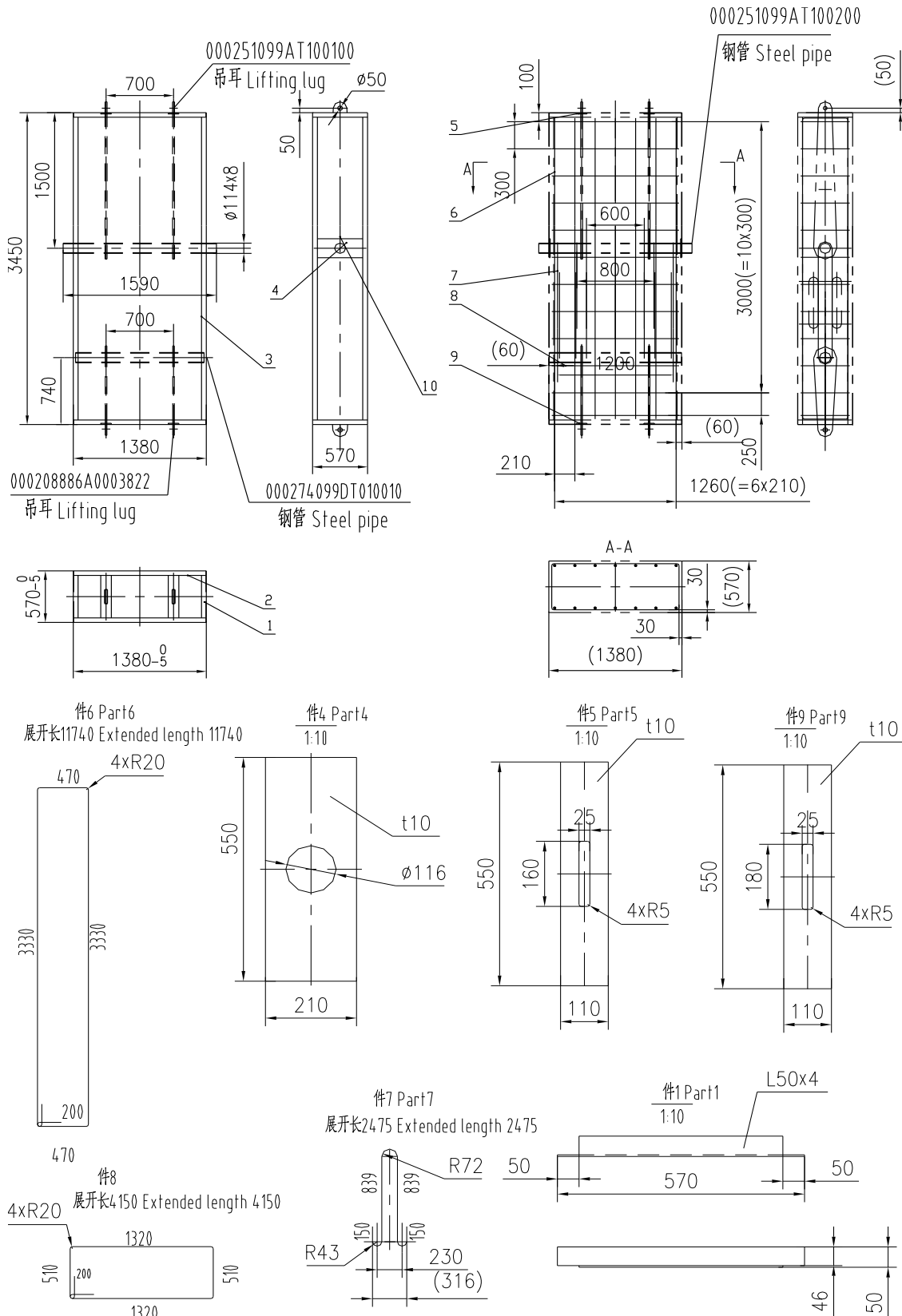


Fig. 3-4 Counter ballast PHZ6500F

Table 3-4 Spare part list of PHZ6500F

No.	Designation	Specification	Qty	Material	Remarks
1	Angle steel	L50×4	4	Q235B	
2	Angle steel	L50×4-1372	4	Q235B	
3	Angle steel	L50×4-3400	4	Q235B	
4	Plate	t10	2	Q235B	
5	Plate	t10	2	Q235B	
6	Rebar	Φ25	7	HRB335	
7	Rebar	Φ25	6	HRB335	
8	Rebar	Φ16	12	HPB300	
9	Plate	t10	2	Q235B	
10	Concrete		1	C25	

3.7 Central ballast

The stationary/travelling chassis tower crane need configure central ballast to avoid falling.

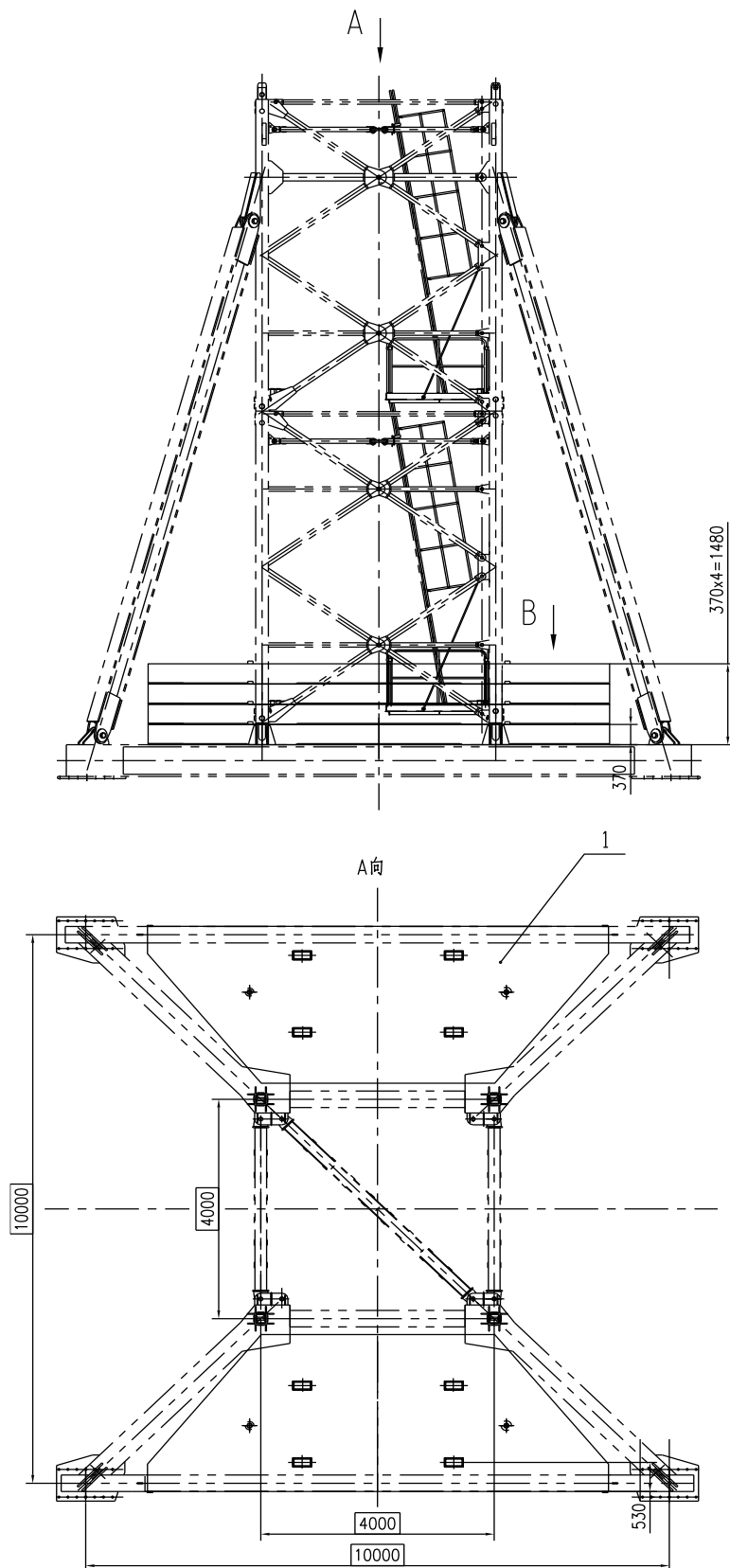
3.7.1 Configuration

The central ballast is **YZ15000** which's weight is **15000 kg**. The quantities are different from different jib lengths and tower section quantities. Refer to table below:

Table 3-5 Central ballast configuration for different height

Quantities of tower sections	Working height /m		Weight (t)	Quantities of YZ15000
	Stationary Chassis	Travelling chassis		
2	24.1	26.0	0	0
3	29.8	31.7	0	0
4	35.5	37.4	0	0
5	41.2	43.1	0	0
6	46.9	48.8	30	2
7	52.6	54.5	30	2
8	58.3	60.2	60	4
9	64.0	65.9	60	4
10	69.7	71.6	90	6
11	75.4	77.3	120	8

3.7.2 Assembly drawing and spare part list of central ballasts



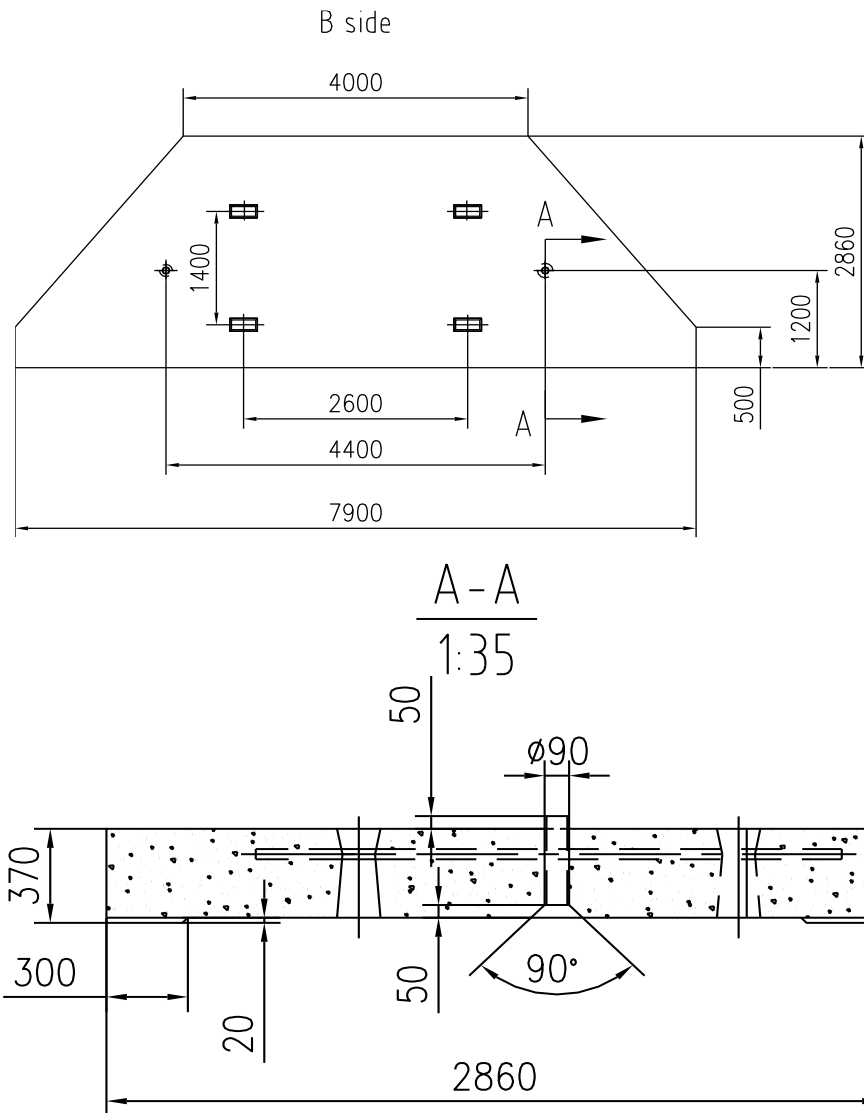
Fig. 3-5 Assembly drawing of **D1100-YZ (000201199A0020000)**

Table 3-6 Spare part list of central ballasts

No.	Order No.	Code	Designation	Qty	Material
1	000209932A0150000	YZ15000	Central ballast 15t	8*	Reinforced Concrete

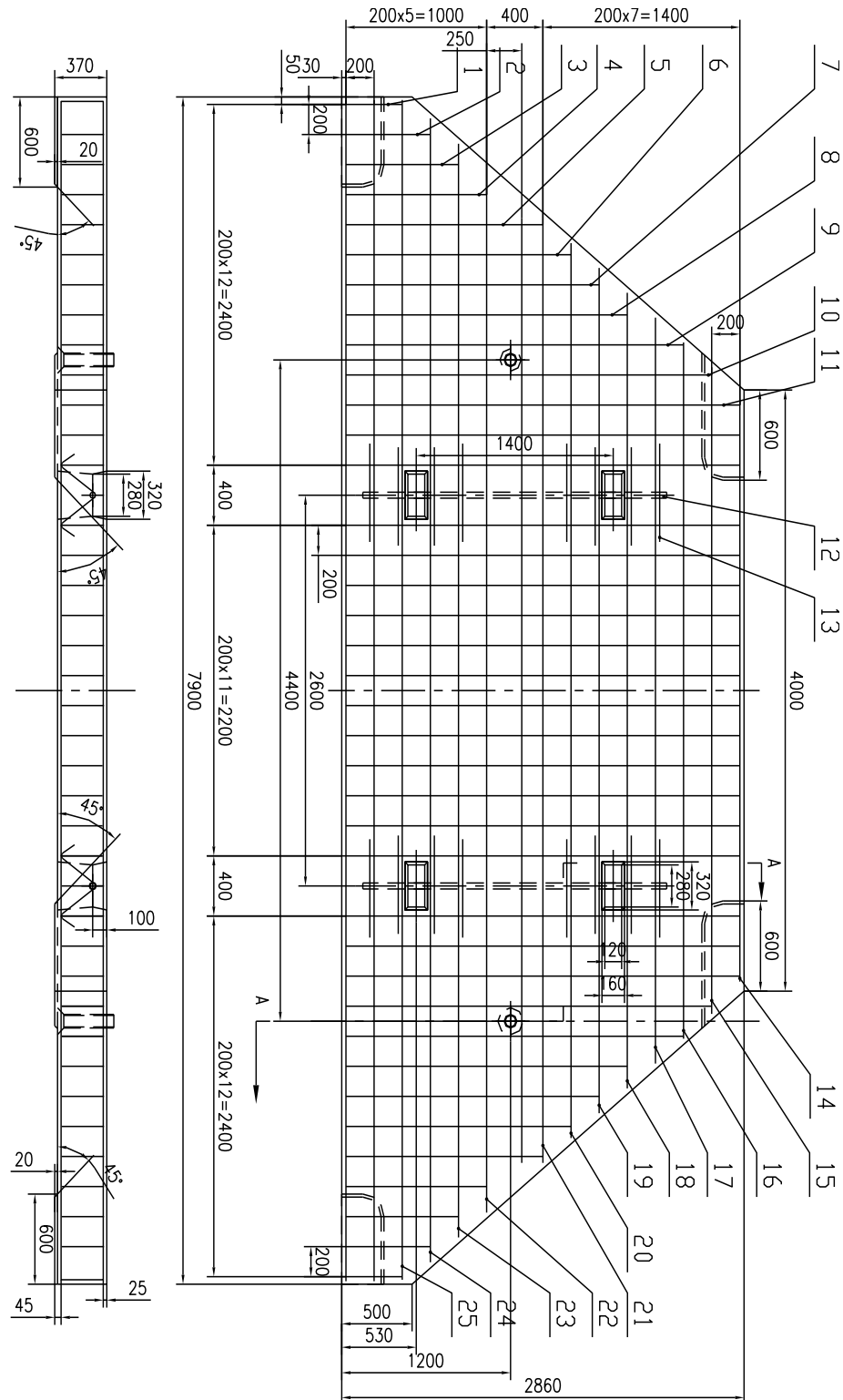
☆ *Adjust the quantities of YZ15000 according to **Section 3.7.1.**

3.7.2.1 Technical requirements

- 1) The protrusion of YZ15000 must be placed on the cross beam symmetrically;
- 2) When installing the central ballasts, use the location holes and location perrons to locate ballasts. Centre line of locating perrons of lower ballast must coincide with center line of location hole of the ballast above;
- 3) All the parts are supplied by users.

3.7.3 Fabrication

- The perron, which's thickness is 20mm, supports the whole weight of the centre ballasts, must be made to be smooth.
- The concrete strength is C30. Stamped concrete, the curing period of the counter-weight must not be less than 14 days after pouring.



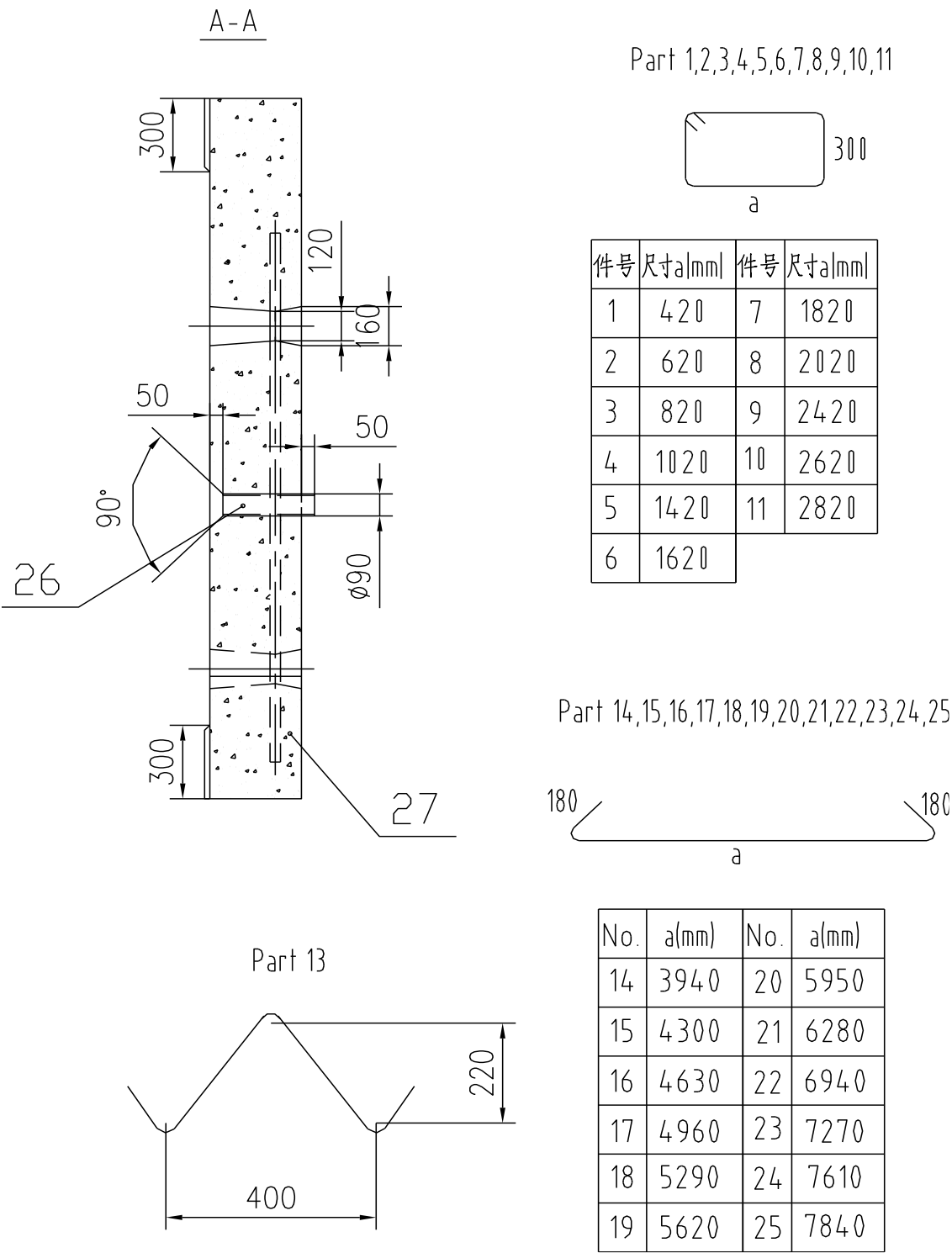


Fig. 3-6 Drawing of Center ballast YZ15000

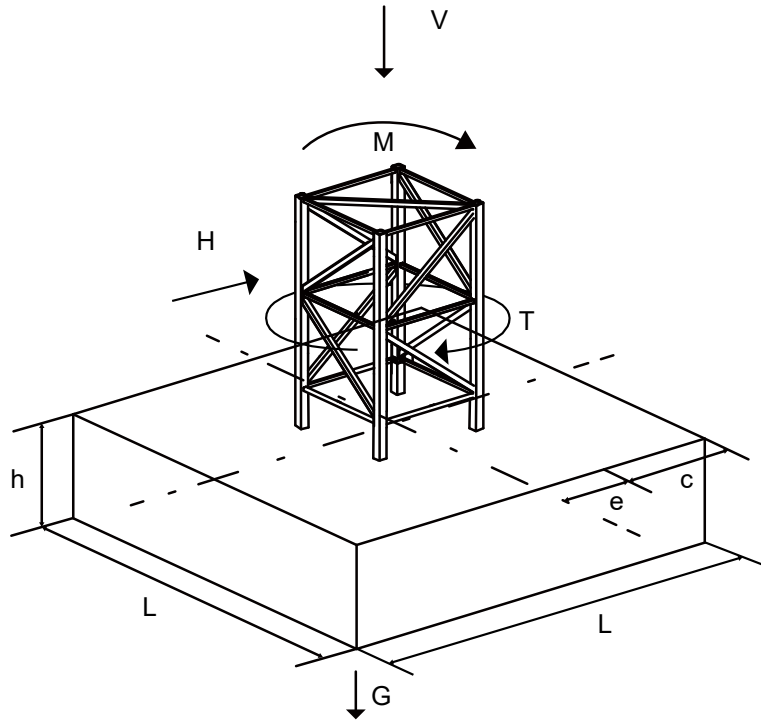
Table 3-7 Spare parts of Center ballast YZ15000

No.	Designation	Specification	Qty	Material
1	Reinforcement	Φ12-1560	2	HPB300
2	Reinforcement	Φ12-1960	2	HPB300
3	Reinforcement	Φ12-2360	2	HPB300
4	Reinforcement	Φ12-2760	2	HPB300
5	Reinforcement	Φ12-3560	2	HPB300
6	Reinforcement	Φ12-3960	2	HPB300
7	Reinforcement	Φ12-4360	2	HPB300
8	Reinforcement	Φ12-4760	2	HPB300
9	Reinforcement	Φ12-5560	2	HPB300
10	Reinforcement	Φ12-5960	2	HPB300
11	Reinforcement	Φ12-6360	18	HPB300
12	Round steel	Φ40-2160	2	Q235B
13	Reinforcement	Φ16-960	8	HRB400
14	Reinforcement	Φ16-4320	2	HRB400
15	Reinforcement	Φ16-4680	2	HRB400
16	Reinforcement	Φ16-5010	2	HRB400
17	Reinforcement	Φ16-5340	2	HRB400
18	Reinforcement	Φ16-5670	2	HRB400
19	Reinforcement	Φ16-6000	2	HRB400
20	Reinforcement	Φ16-6330	2	HRB400
21	Reinforcement	Φ16-6660	4	HRB400
22	Reinforcement	Φ16-7320	2	HRB400
23	Reinforcement	Φ16-7650	2	HRB400
24	Reinforcement	Φ16-7990	2	HRB400
25	Reinforcement	Φ16-8220	6	HRB400
26	Steel pipe	Φ90×6.5-350	2	Q235B
27	Concrete		1	C30

3.8 Foundation

3.8.1 Calculating method

■ Calculate of eccentricity



As the figure, the stability condition of tower crane as the following:

$$e = \frac{M + H * h}{V + G} \leq \frac{L}{3}$$

In the formula:

e—eccentricity, that is the distance between the resultant ground reaction and the base center, m;

G—the gravity of the concrete foundation, kN.

■ Calculation of earth bearing pressure

Earth endurance should not exceed the maximum permissible stress of the ground!

Earth endurance checking formula:

$$\sigma_B = \frac{2 * (V + G)}{3 * L * c} \leq \sigma_{Bp}$$

$$c = \frac{L}{2} - e$$

In the formula:

σ_B —Calculation the compressive stress on the ground, MPa;

σ_{Bp} —Allowable compressive stress on the ground, MPa: It shall be determined by the situation of investigation and foundation treatment.

3.8.2 Foundation of outrigger stationary tower crane

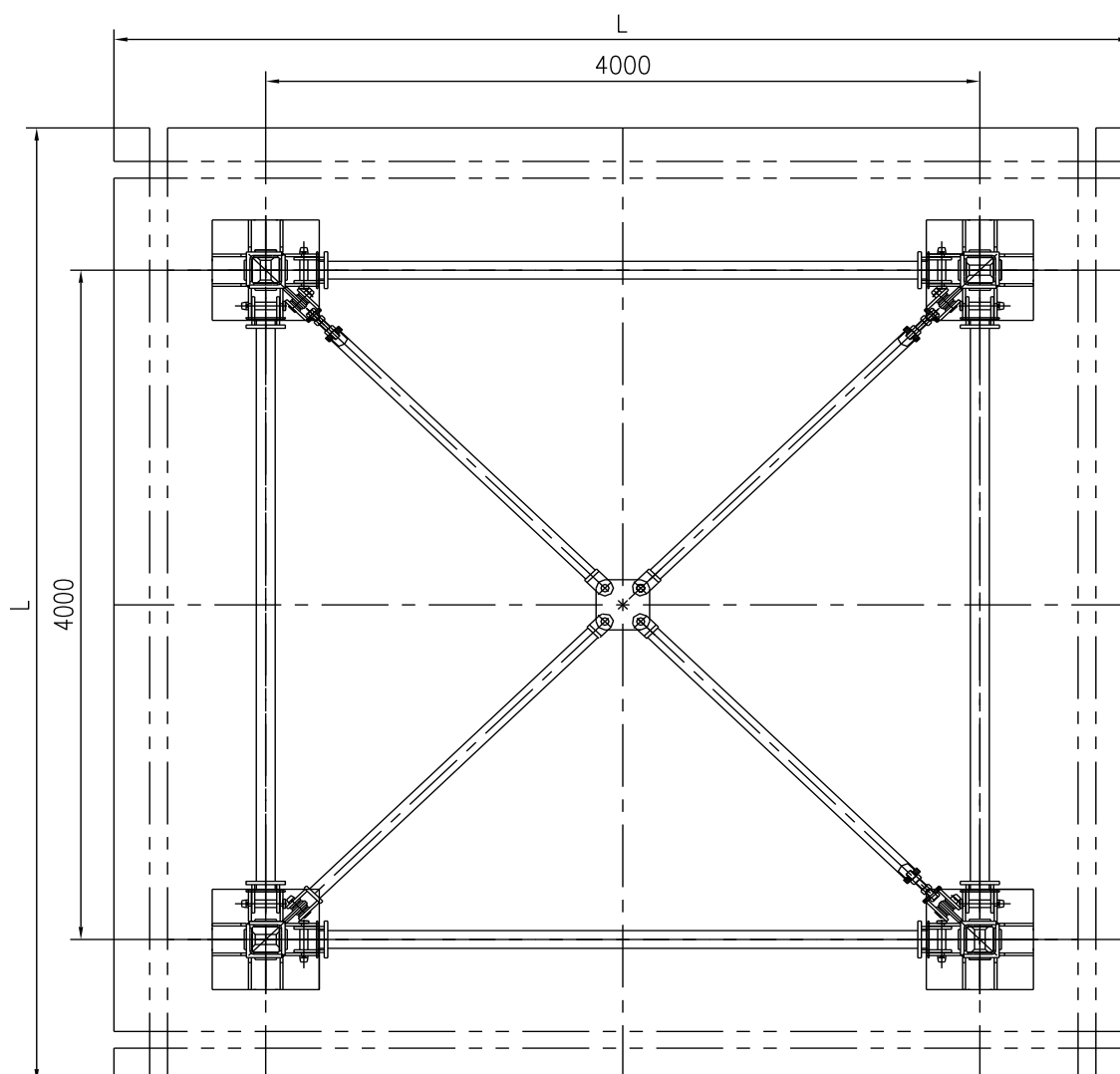
The ground foundation is the precondition to ensure safe operation of the crane. It is made of reinforced concrete as shown in Fig. 3-7. Basic requirements are shown as follows:

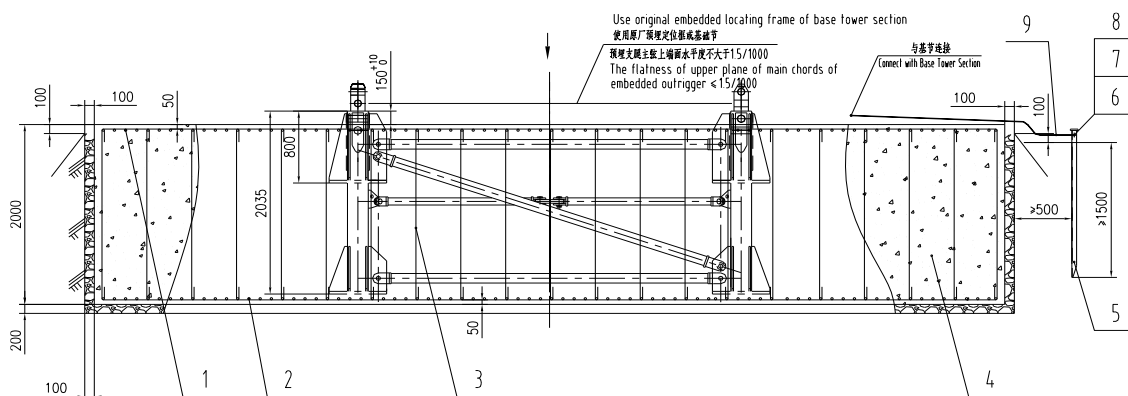
- 1) Excavate a trench to hard formation until the ground bearing pressure accords with the value in the following table, and make the bottom level. And then backfill and tamp **200mm** gravel stratum. After making formwork or laying bricks for the side walls, pour concrete into pre-made reinforced rod net. The concrete block surface should be **100mm** higher than neighboring ground for the drainage of storm water, then removal the formwork and backfill the neighboring ground with gravels.
- 2) The depth of the concrete cover of the main reinforcement is **50mm**. Fix the embedded anchors on the locating reinforcement bar and make sure that the verticality of the embedded anchors centerlines and horizontal plane is less than **1.5/1000**. Concrete filling rate around the embedded anchors must be over **95%**.
- 3) The concrete strength grade shall be no less than **C35**. The curing duration of concrete is more than **15** days.
- 4) If it is difficult to pass through the anchor, the main reinforcing rod can be turned aside, but must not be reduced or cut off.
- 5) **No.5** which must drive at least **1.5m** into the ground. Not connected with the steel reinforcement of the building foundations.
- 6) The **No.9** is insulated copper cable with at least **16mm²**.
- 7) This foundation is supposed to be applied for **T1200-64Q** tower crane with the standard free-standing height of **86.0 m** and for **T1200-64Q** tower crane which is attached to the building and in accordance with the requirement in the user's manual. The load on the foundation can be found in the user's manual. The load-bearing capacity of the foundation, the dimension L of the foundation and the layout of the reinforcement are all designed in accordance with the standard FEM. The foundation can be produced under instruction of the following table, the adjustment according to the actual situation is also allowed:



If the modified bearing capacity of foundation is less than 0.1 MPa, the pile foundation must be adopted. The pile foundation can also be adopted, when the block foundation cannot be produced as above due to the size limitation or other inevitable reasons.

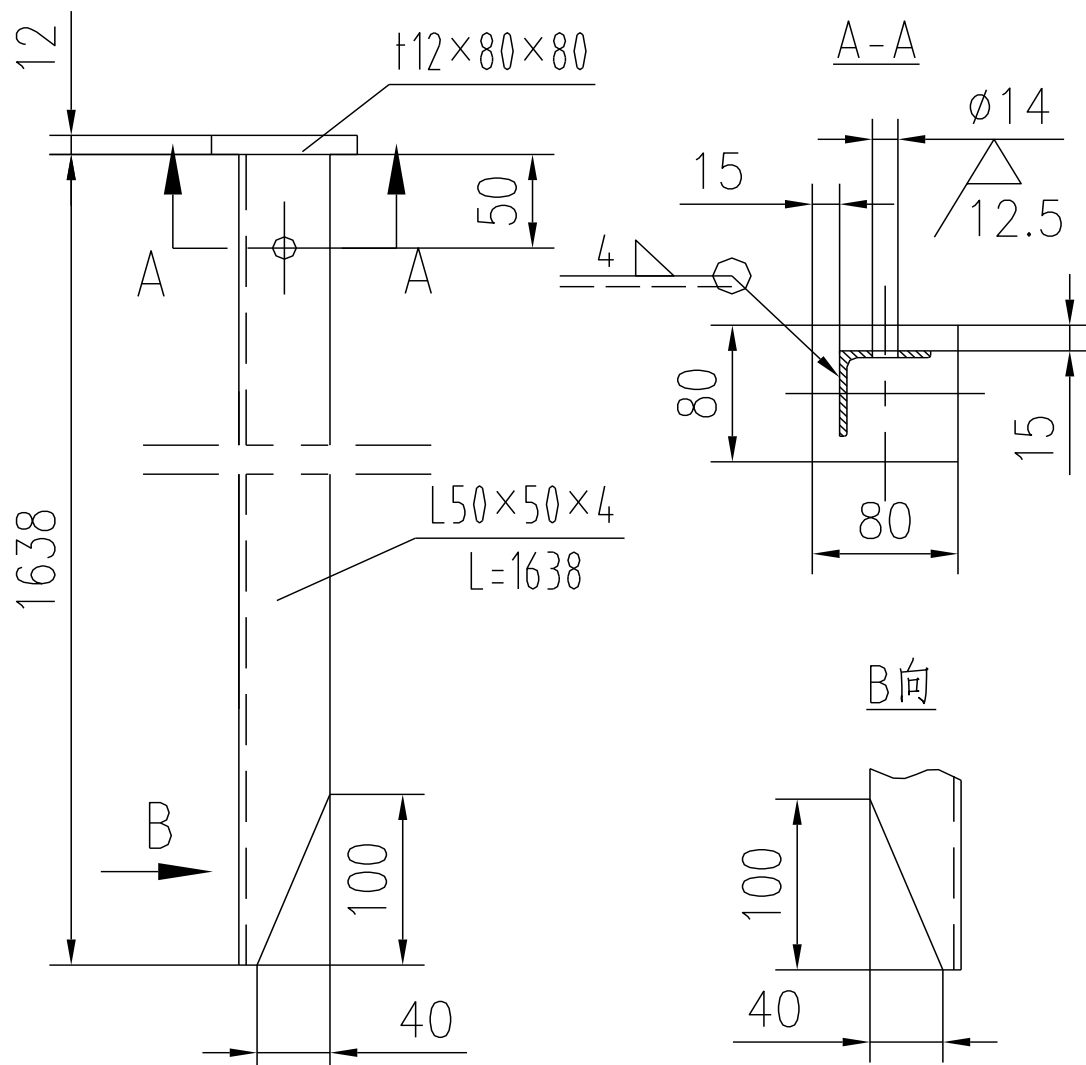
L	Main reinforcement A/B	a (mm)	Ground resistance (MPa)	Concrete volume (m ³)	Weight (t)	Qty. of No.3
10000	Lengthwise and crosswise: 60×Φ32	9900	0.24	200	480	900
11000	Lengthwise and crosswise: 60×Φ32	10900	0.19	242	580.8	900
12000	Lengthwise and crosswise: 60×Φ32	11900	0.16	288	691.2	900





序号5 No.5 Earthing rod
1:5

可从我公司订购
Can be ordered from ZOOMLION.



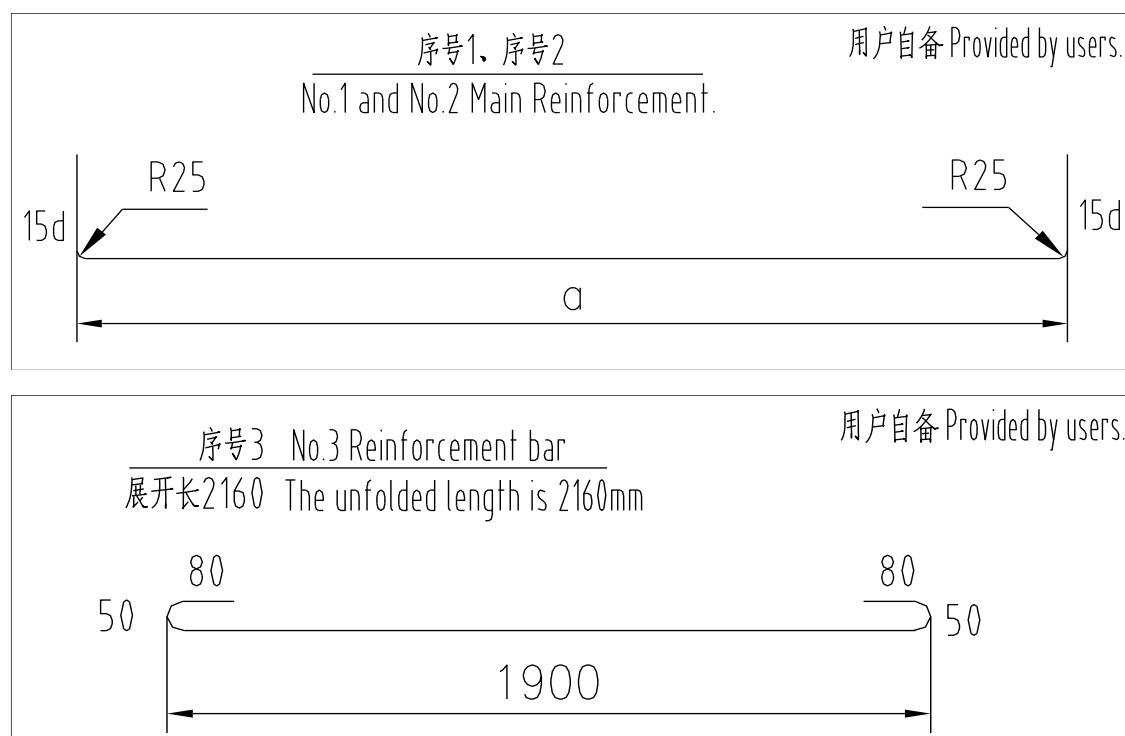


Fig. 3-7 Foundation drawing of outrigger stationary tower crane

Table 3-8 Spare parts list of outrigger stationary tower crane foundation

No.	Description	Specification	Qty	Material	Remarks
1	Main rebar A		120	HRB400	
2	Main rebar B		120	HRB400	
3	Reinforced rebar	Φ14-2160	900	HPB300	
4	Concrete		1	C35	
5	Earthing rod		1	Weldment	
6	Bolt	M12×40-8.8	1		Zn.D
7	Washer	12	1	65Mn	
8	Nut	M12-8	1		Zn.D
9	Earthing cable		1		

3.8.2.1 Assembling the base tower section

- 1) As shown in figure below, the main chord I and main chord II are assembled into piece A. The required components for the assembly are shown in table below (pay attention to the step direction in the picture)

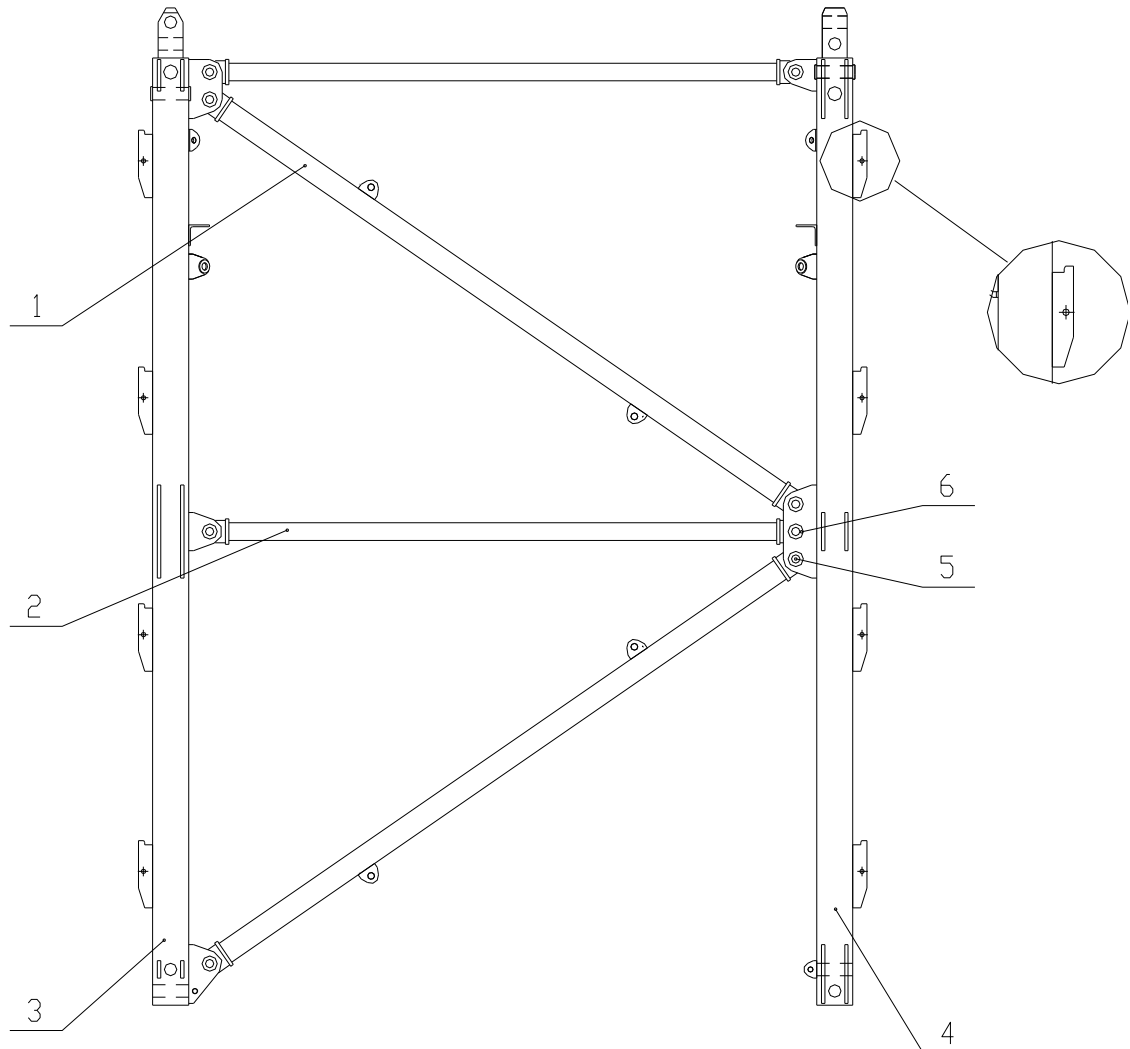


Fig. 3-8 Assembly of piece A

Table 3-9 Parts of assembling step 1

No.	Designation	Specification	Qty
1	Diagonal web member		2
2	Straight web member		2
3	Main chord I		1
4	Main chord II		1
5	Pin	$\Phi 50 \times 175$	8
6	Washer	t8	8

- 2) The chord II, the horizontal web member and the diagonal web member are assembled into piece B, as shown in figure below. The required components are shown in table below.

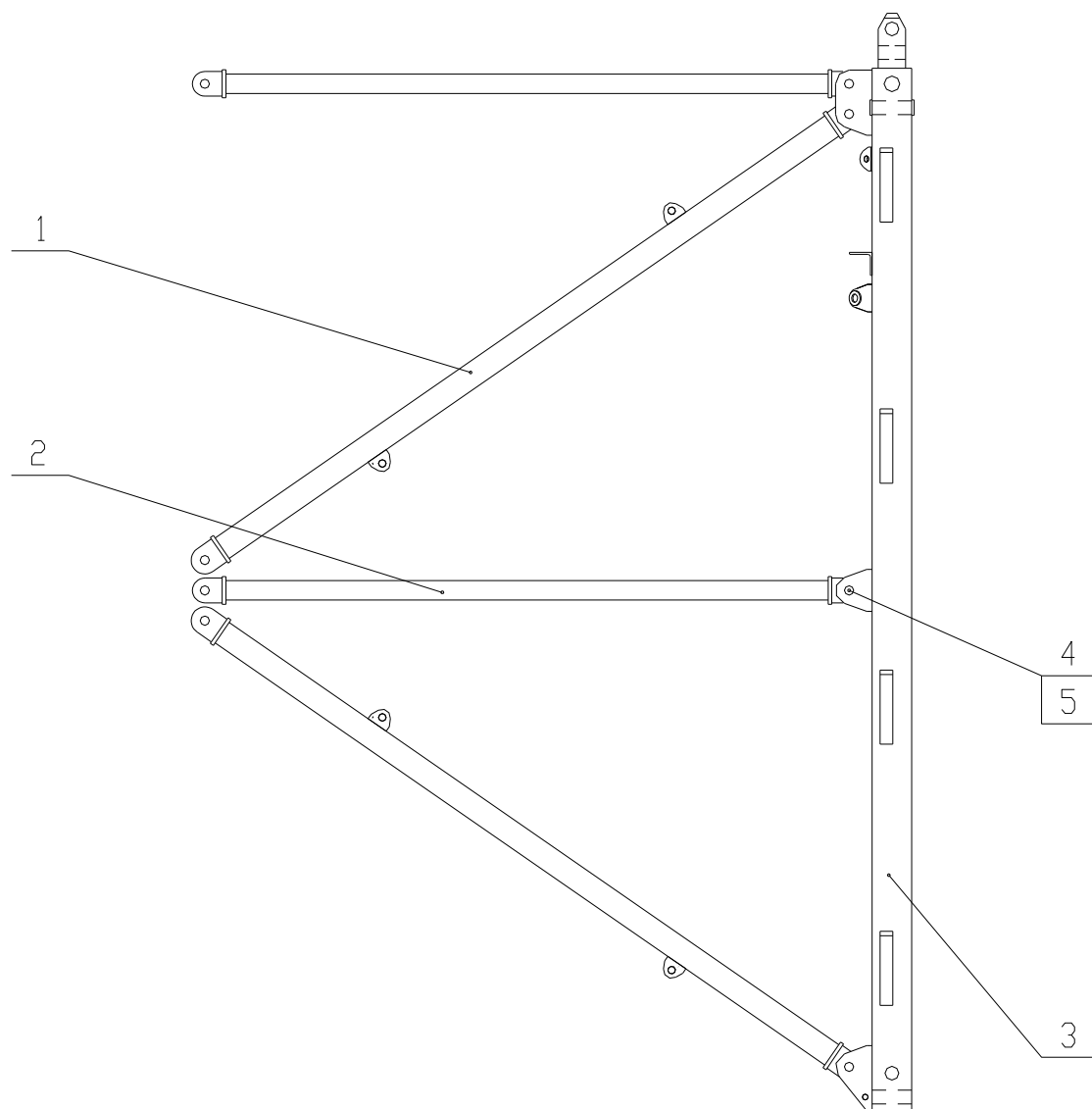


Fig. 3-9 Assembly of piece B

Table 3-10 Parts of assembling step 2

No.	Designation	Specification	Qty
1	Diagonal web member		2
2	Straight web member		2
3	Main chord		1
4	Pin	$\Phi 50 \times 175$	4
5	Washer	t8	4

- 3) Placing piece A on the ground and hoisting piece B, see figure below. For the required components, refer to table below.

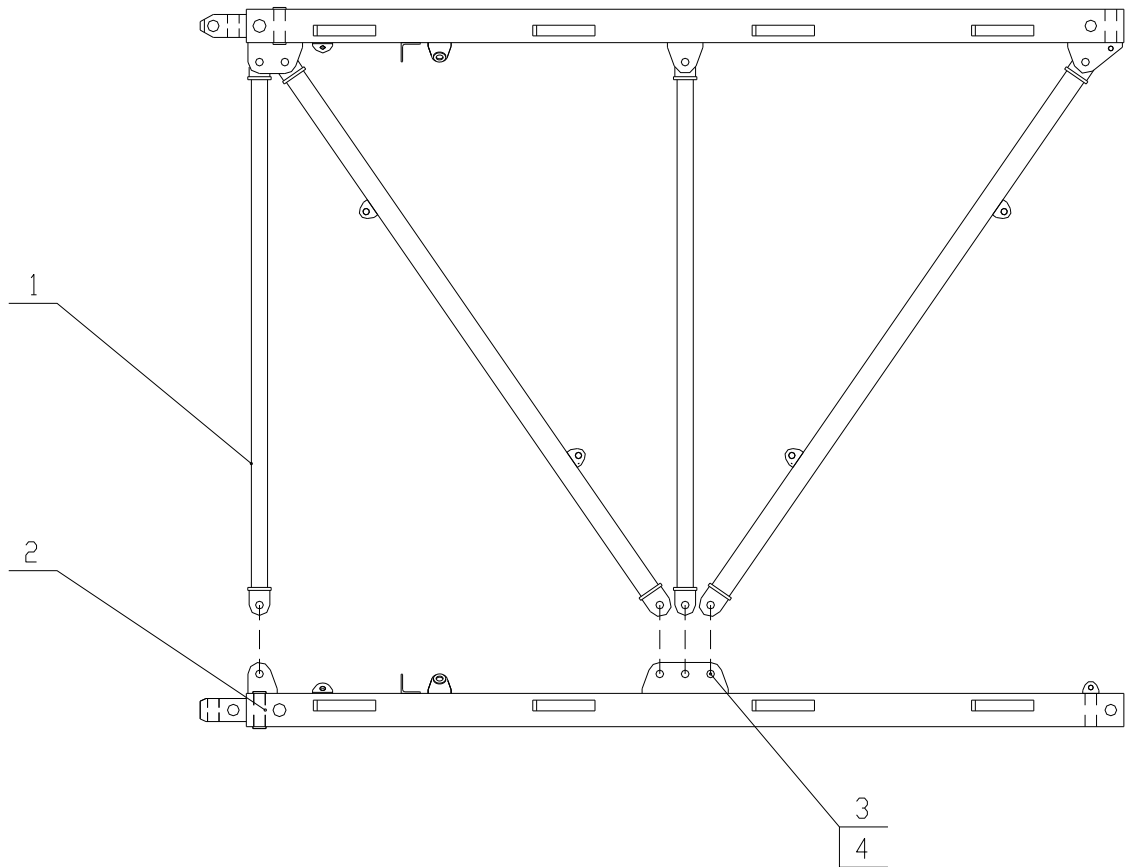


Fig. 3-10 Assembly of piece A and piece B

Table 3-11 Parts of assembling step 3

No.	Designation	Specification	Qty
1	Piece B		1
2	Piece A		1
3	Pin	$\Phi 50 \times 175$	4
4	Washer	t8	4

- 4) Repeating the assembly method of piece B, use the main chord I, the horizontal web member and the diagonal web member to assemble piece C. Piece C, piece A and piece B are assembled into tower section structure, as shown in figure below. The required components are shown in table below.

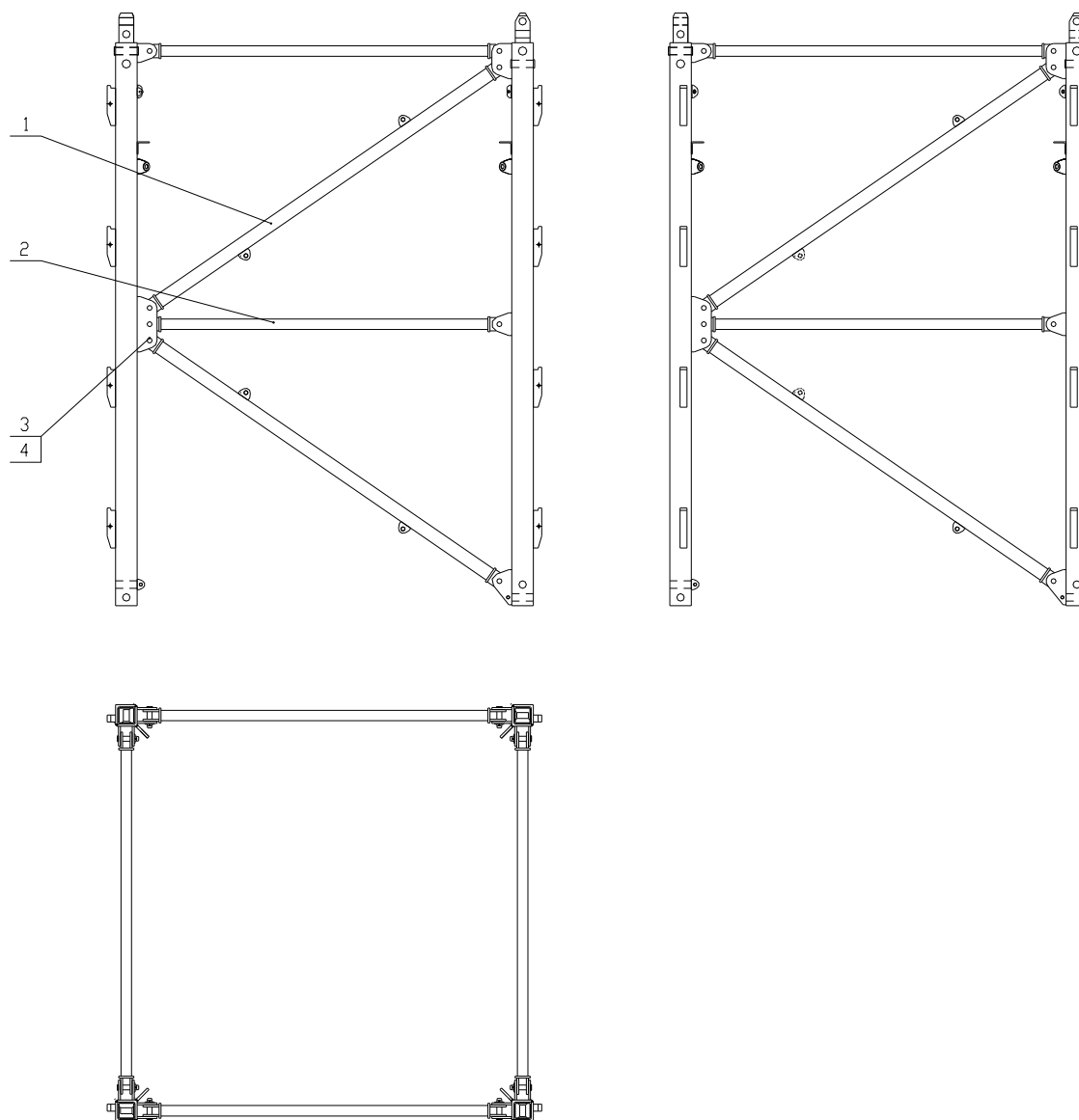


Fig. 3-11 Assembly of piece C

Table 3-12 Parts of assembling step 4

No.	Designation	Specification	Qty
1	Diagonal web member		2
2	Straight web member		2
3	Pin	$\Phi 50 \times 175$	4
4	Washer	t8	4

- 5) Install the diagonal strut (fixed strut and adjusting strut). The diagonal error should be adjusted to less than 1.5mm by using the adjusting pole to ensure the smooth installation of the tower section. The installation method is shown in figure below, and the assembly parts are shown in table below.

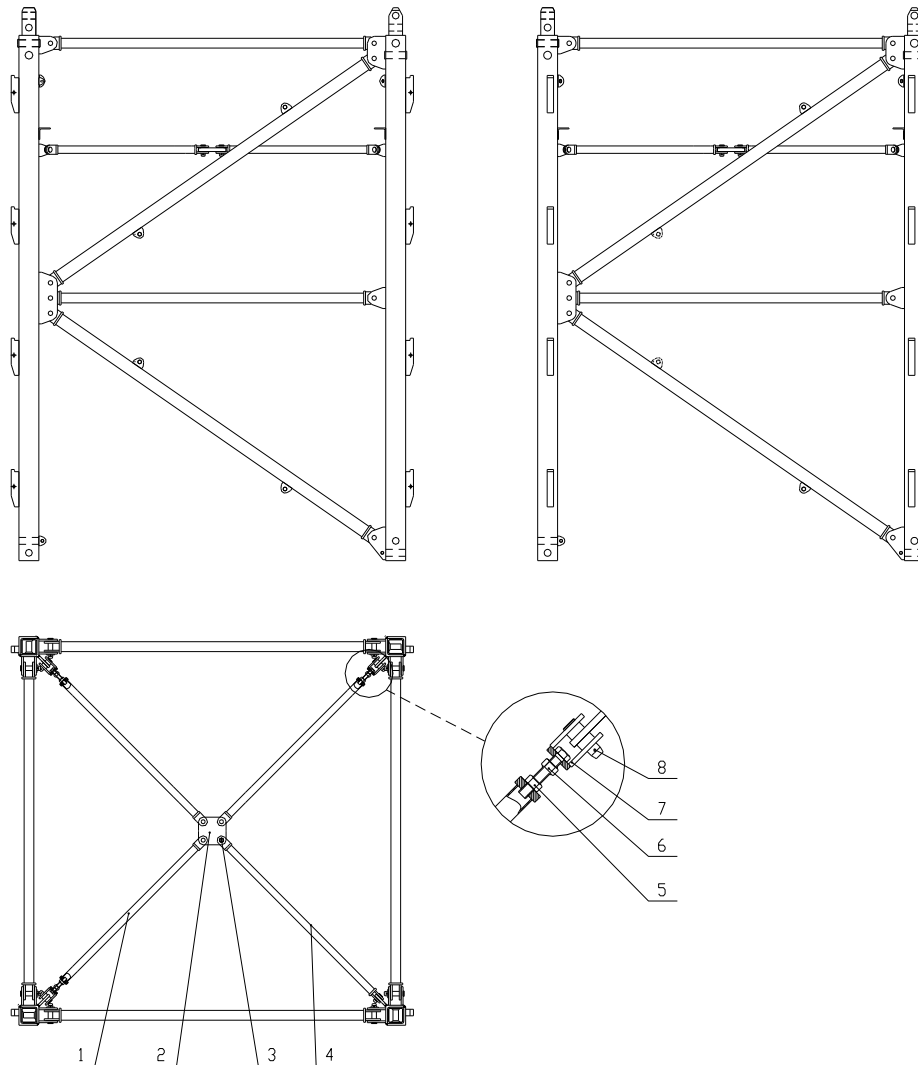


Fig. 3-12 Assembly of diagonal strut

Table 3-13 Parts of assembling step 5

No.	Designation	Specification	Qty
1	Adjustment strut		3
2	Connection plate		1
3	Pin B	$\Phi 45 \times 90$	4
4	Strut		1
5	Nut	M36-8	3
6	Adjustment bolt		3
7	U-sheet plate		3
8	Pin	$\Phi 45 \times 120$	4

- 6) Install the platform, long ladder and retainer according to the attached figure below. See table below for the assembly parts.

Pay attention to the direction of platform, ladder and step.

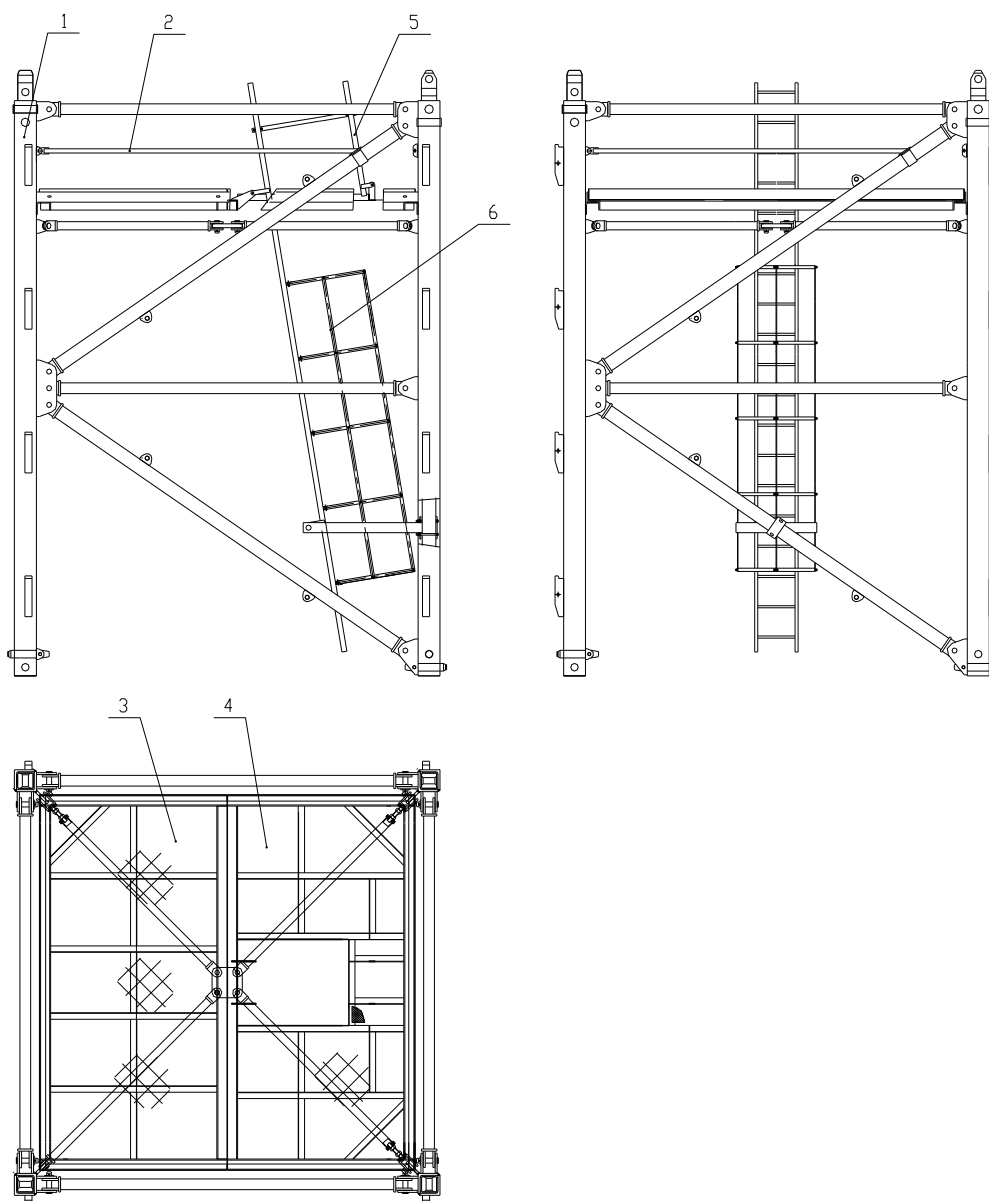


Fig. 3-13 Assembly of platforms, ladder and retainer

Table 3-14 Parts of assembling step 6

No.	Designation	Specification	Qty
1	Structure		1
2	Cross bar		4
3	Platform D		1
4	Platform E		1
5	Short ladder		1
6	Ladder and retainer		1

- 7) The assembling steps of the reinforced tower section of tower sections are the same with the steps above. For the base tower section, it needs to install nameplate, nameplate support and knife switch support in addition. The parts are shown in table below.

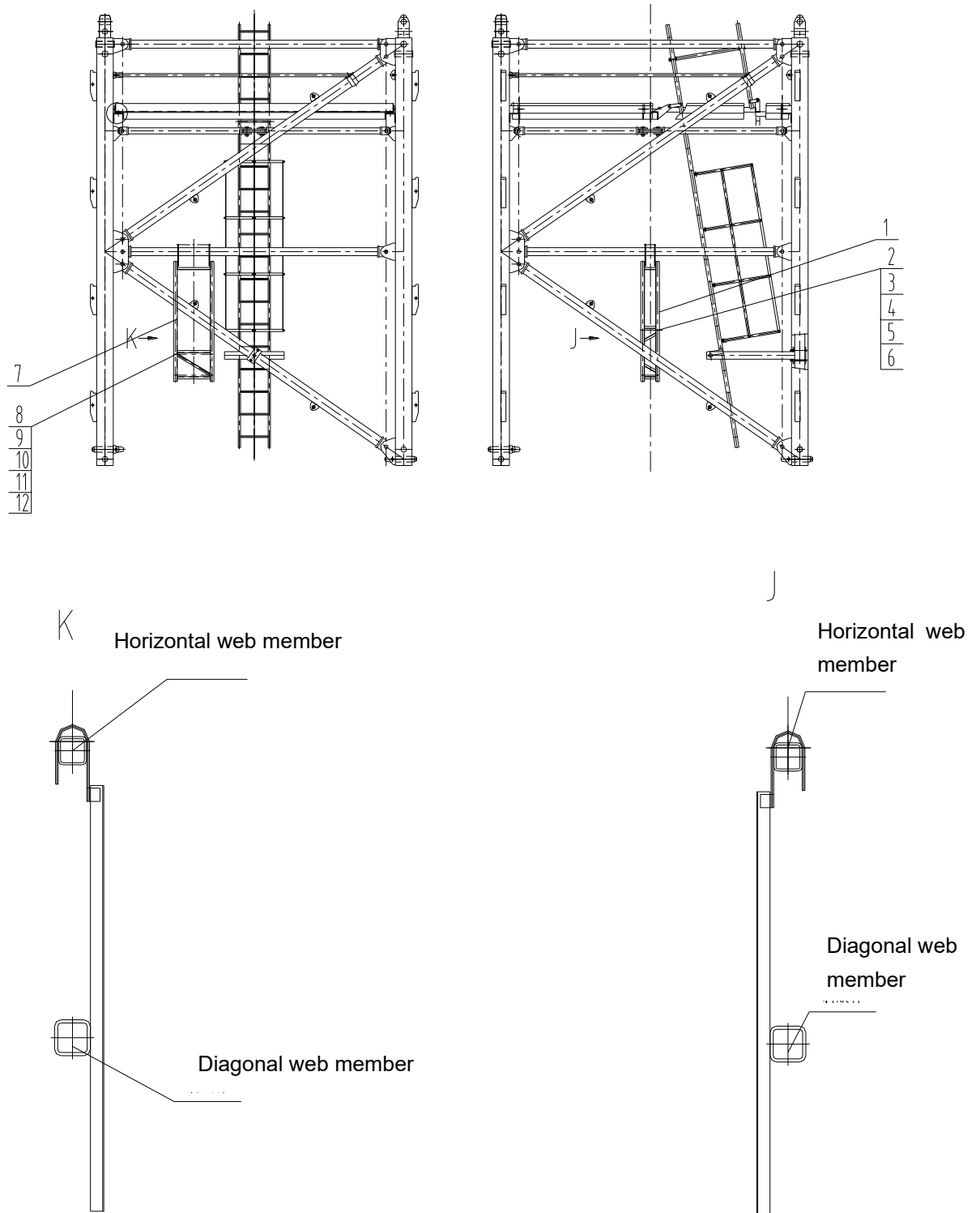


Fig. 3-14 Assembly of nameplate, nameplate support and knife switch support

Table 3-15 Parts of assembling step 7

No.	Designation	Specification	Qty
1	Knife switch support		1
2	Bolt	M8×30-8.8	4
3	Nut	M8-8.8	4
4	Washer	8	4
5	Washer	8-200HV	4
6	Knife switch		1
7	Nameplate support		1
8	Bolt	M6×16-8.8	4
9	Nut	M6-8	4
10	Washer	6	4
11	Washer	6-200HV	4
12	Nameplate		1



Ensure all the connecting holes and pins are clean and no dirt. Refer to Section 6.13.

3.8.2.2 Assembling the outrigger and base tower section

- Assemble the outrigger as the figure below.

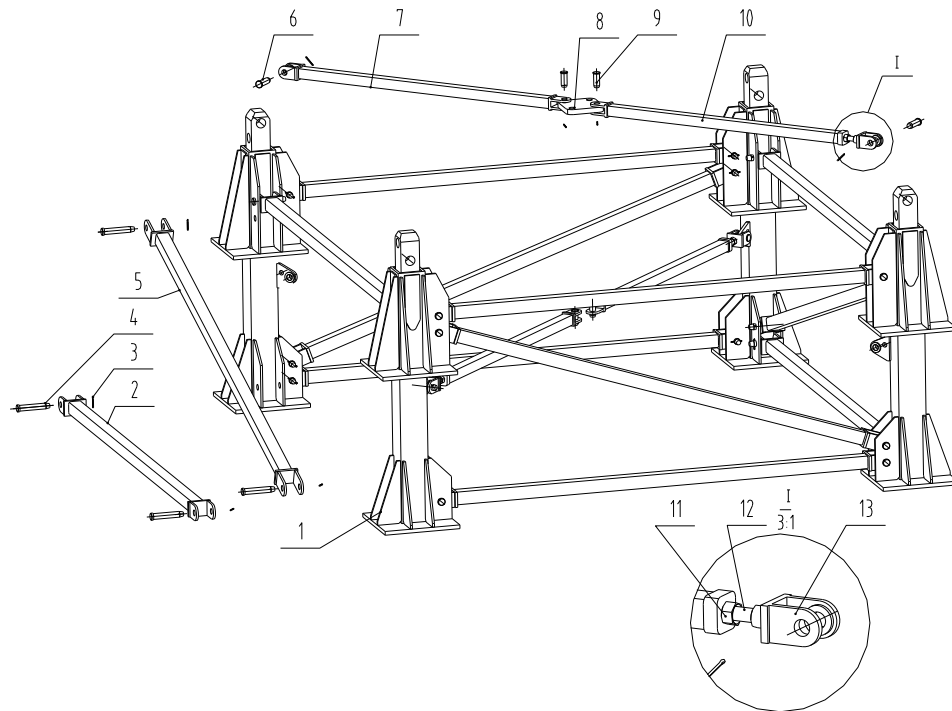


Fig. 3-15 Assembly of outrigger

Table 3-16 Parts of outrigger

No.	Designation	Specification	Qty
1	Outriggers		4
2	Straight web member		8
3	Split pin	8×71	32
4	Pin		24
5	Diagonal web member		4
6	Pin A		4
7	Brace rod		1
8	Connecting plate		1
9	Pin		4
10	Adjusting brace rod		3
11	Nut	M36-8	3
12	Adjusting screw		3
13	U-plate		3

- Assemble the outrigger and the base tower section together by 8 pins of $\Phi 75$, knock the pin shoulders to fit the surface of the chords. Then insert the split pins and spring pins.



Only when the pin-lock holes and the anti-rotate holes are coaxial the lock pins can be inserted.

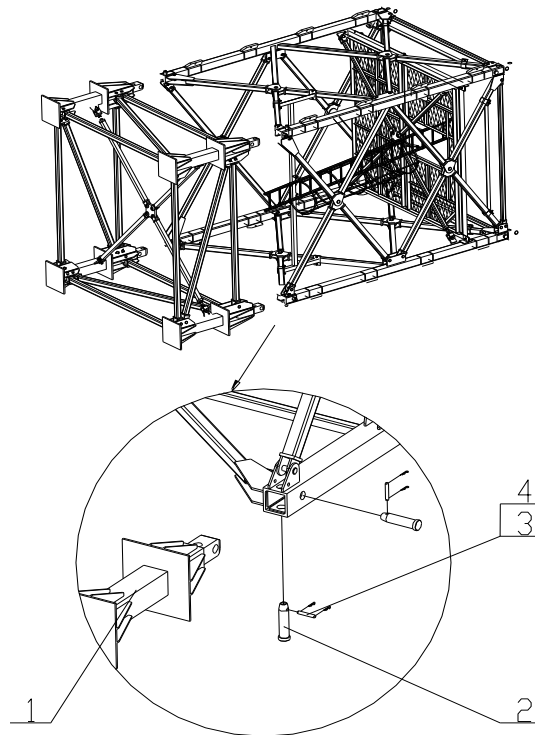


Fig. 3-16 Assembling the outrigger and base tower section

Table 3-17 Parts of outrigger

No.	Designation	Specification	Qty
1	Outrigger		4
2	Pin C	$\Phi 75 \times 290$	8
3	Lock pin	$\Phi 25 \times 175$	8
4	Spring pin	d1=6.3	16

- 1) For the construction convenience, when the rebars of the foundation are tied at a certain extent, hoist the outriggers and the base tower section as a whole and set in the rebar nets of the foundation.



- The two surfaces with steps of the base tower section should be vertical with the building.
- The rebars surrounding the outriggers can't be reduced or cut.
- The mounting direction for climbing should confirmed. According to the direction, the climbing direction of the ladders should fit the skylight of the turntable and slewing support (When you standing on the slewing support and facing the jib fixing direction, the skylight is on your right side).

- 2) Pour the concrete into the foundation pit.



- The strength level of the concrete can't be less than C35.
- Before pouring the concrete, hang a plumb line at the center of the base tower section to correct the perpendicularity of the horizontal plane of the section.
- After pouring the foundation, the perpendicularity of the center line and the horizontal plane of the base tower section must be $\leq 1/1000$, the four outriggers connecting to the tower section's end planes can form a plane, the levelness of the plane must be $\leq 2\text{mm}$.
- The filling rate of the concrete surrounding the outriggers must be over 95%.

3.8.2.2.1 Grounding

- 1) Before operating the tower crane, the operator must consider the grounding, refer to the figure below if need.
- 2) Adopt the grounding way according to the relevant rules from the regulator.

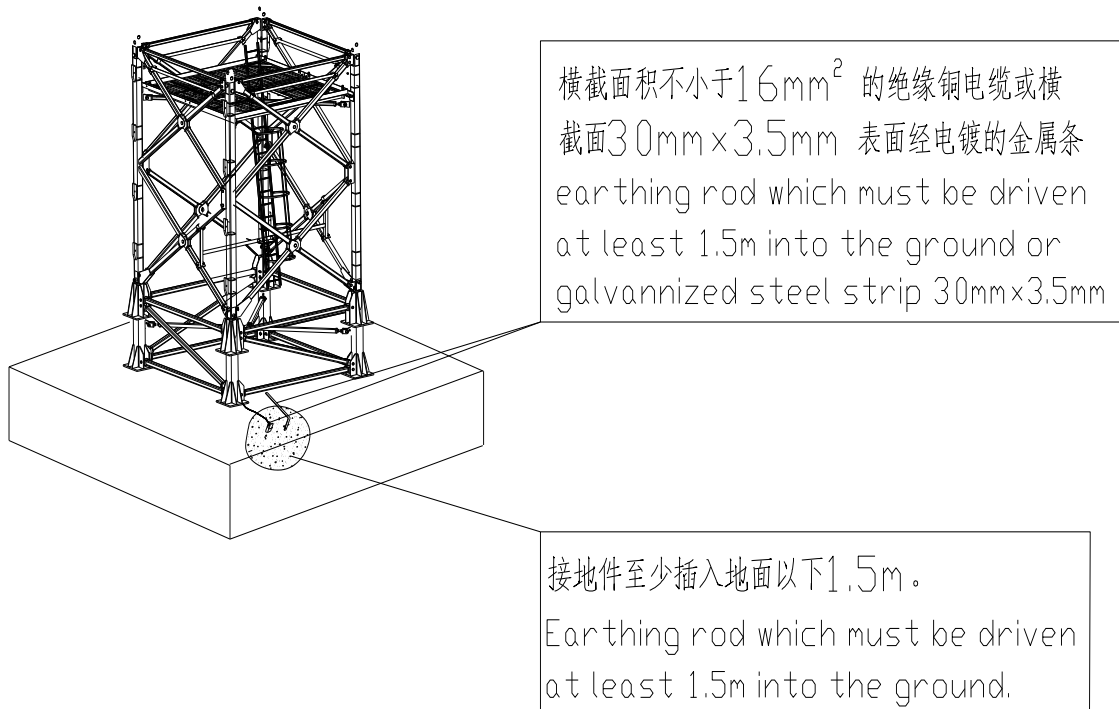


Fig. 3-17 Grounding of the tower crane

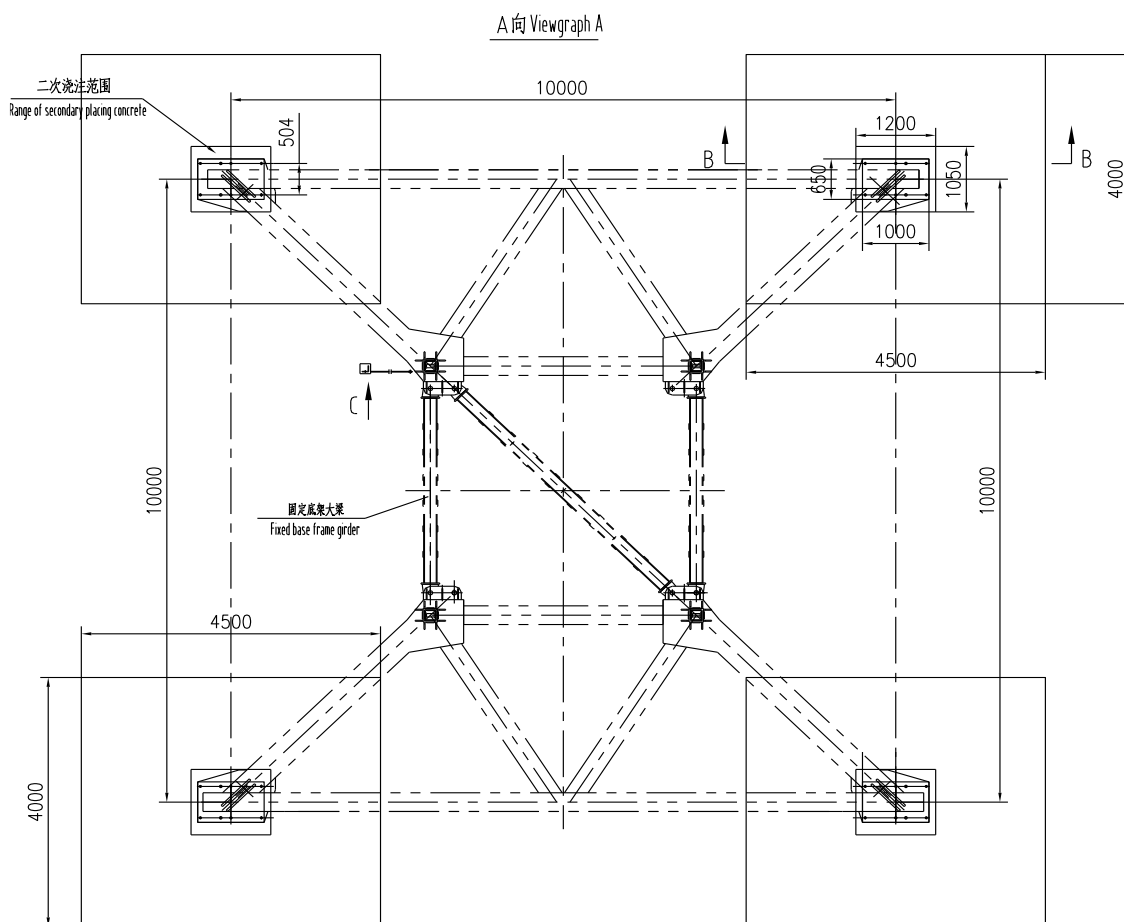


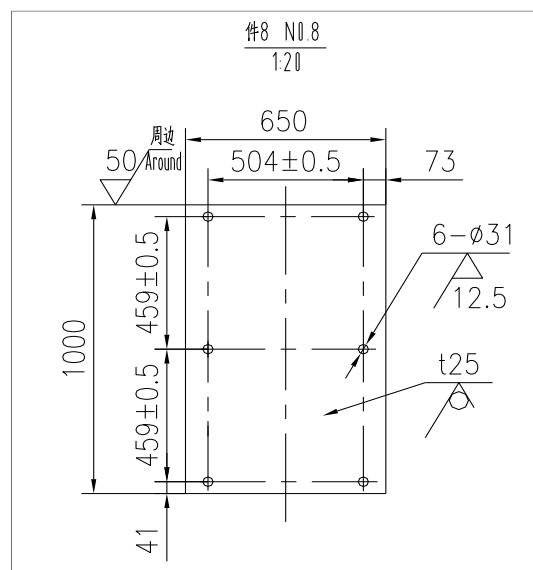
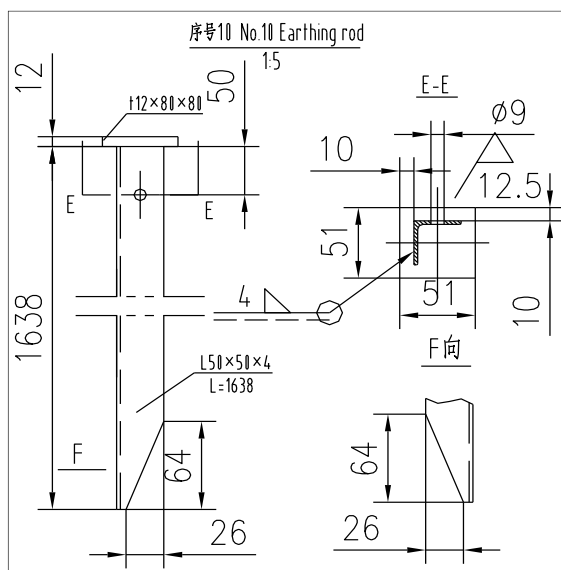
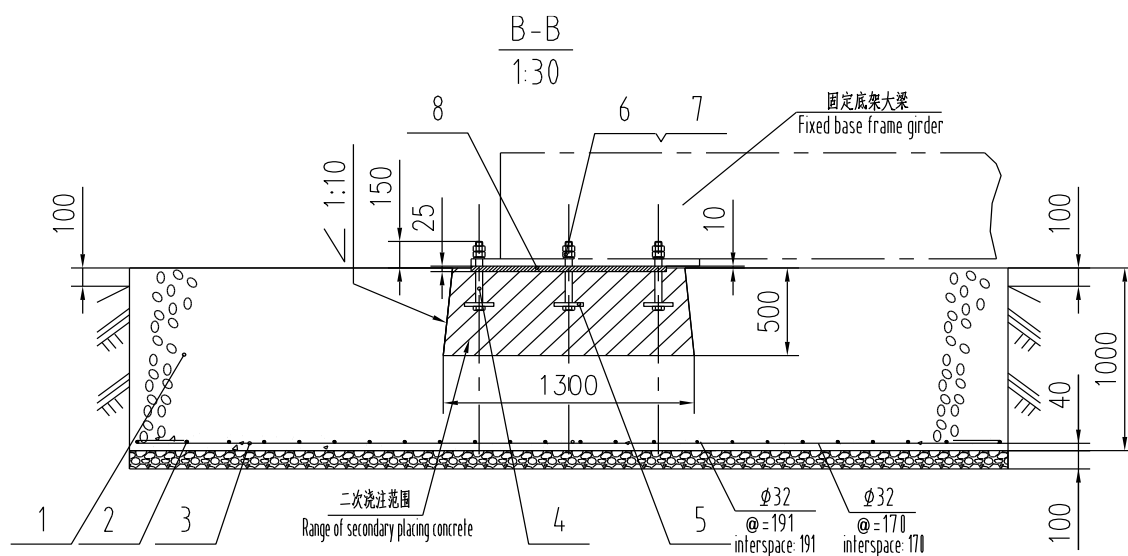
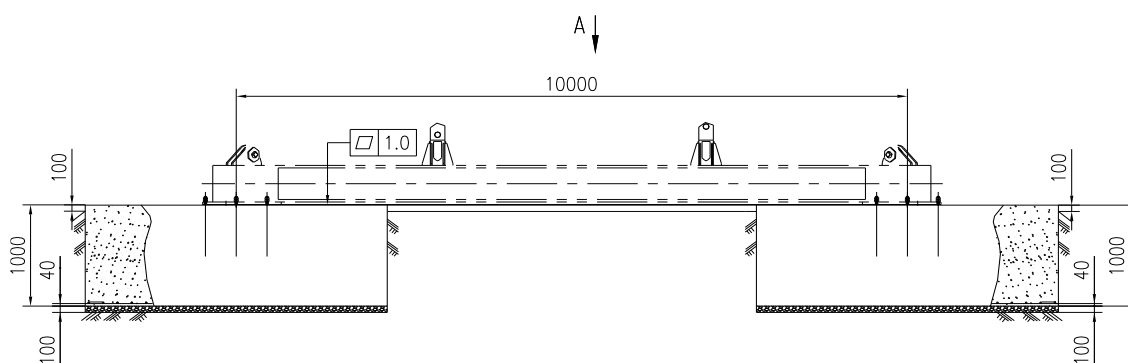
Do not connect the grounding line to the foundation of the building!

3.8.3 Foundation of stationary chassis tower crane

Make the foundation of stationary chassis tower crane according to the technical requirements and drawings below:

- Foundation must be dug to original soil. the foundation load-bearing capacity is more than **0.20Mpa**. Carry out leveling and refilling **100mm** pebbles and tamping them before rebar binding, then place concrete the concrete surface is more **100mm** higher than the foundation around it for better water drainage. If concrete placing within form, refill pebbles and tamp them for torsion resistance after form dismantling.
- **40mm** main rebar protection layer. Ground bolts to be embedded at the above-shown position through pallets holes. Embedment positions shall be concrete, and filling rate around pallets is **>95%**.
- Concrete grade **C35**, curing period longer than **15** days.
- **No.10** must be inserted into the ground for at least 1.5m. Not connected with the steel reinforcement of the building foundations.
- The **No.9** is insulated copper cable with at least **16mm²**.
- The foundation is fit for **T1200-64Q** tower crane of **81.2 m** standard free-standing height.
- All materials and parts should be provided by user.





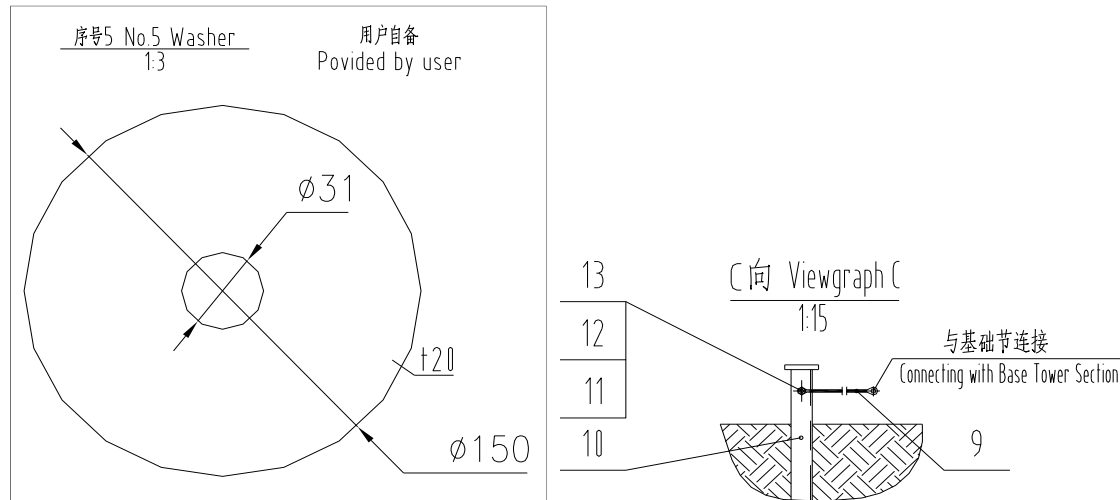


Fig. 3-18 The foundation of stationary chassis tower crane

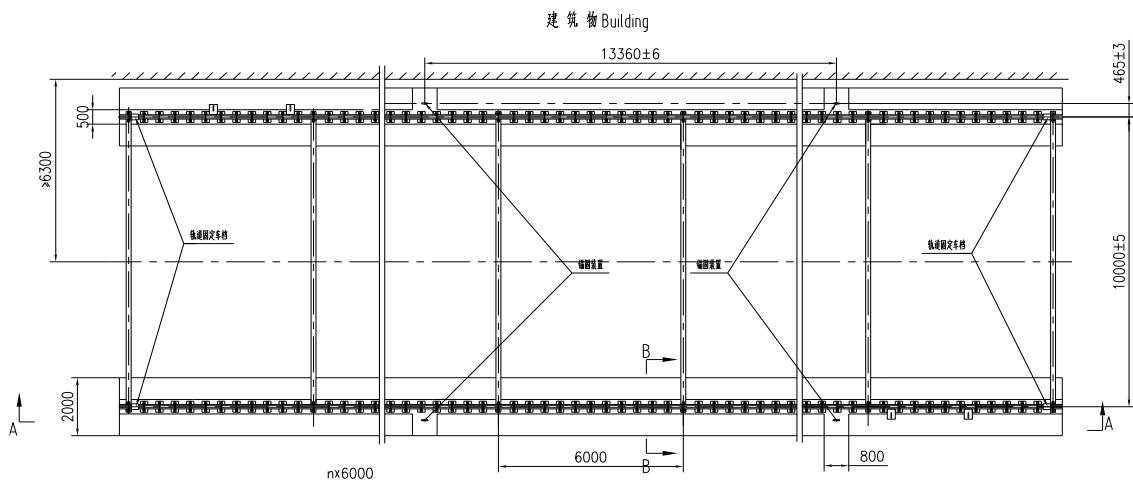
Table 3-18 Spare part list of stationary chassis tower crane foundation

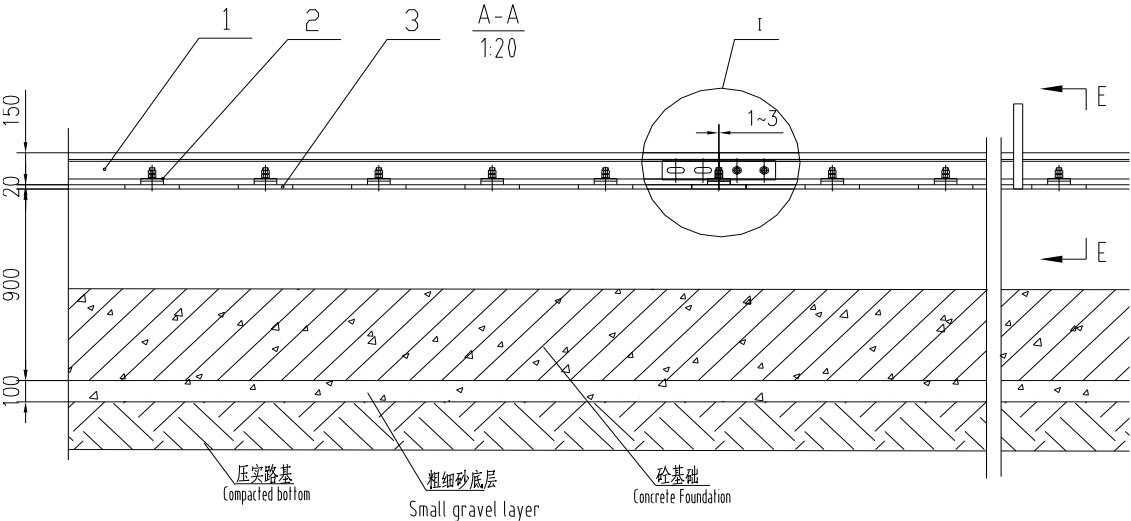
No.	Description	Specification	Qty	Material	Remarks
1	Concrete		4	C35	
2	Twisted steel		96	HRB400	
3	Twisted steel		96	HRB400	
4	Bolts	M30×360-8.8	24		
5	Washer	t20	24	Q235B	
6	Nut	M30-8	48		
7	Washer	30-200HV	24		
8	Packing	t25	4	Q235B	
9	Earthing cable		1		
10	Earthing rod		1	Weldment	
11	Bolt	M12×40-8.8	1		Zn.D
12	Washer	12	1	65Mn	
13	Nut	M12-8	1		Zn.D

3.8.4 Foundation of travelling crane tower crane

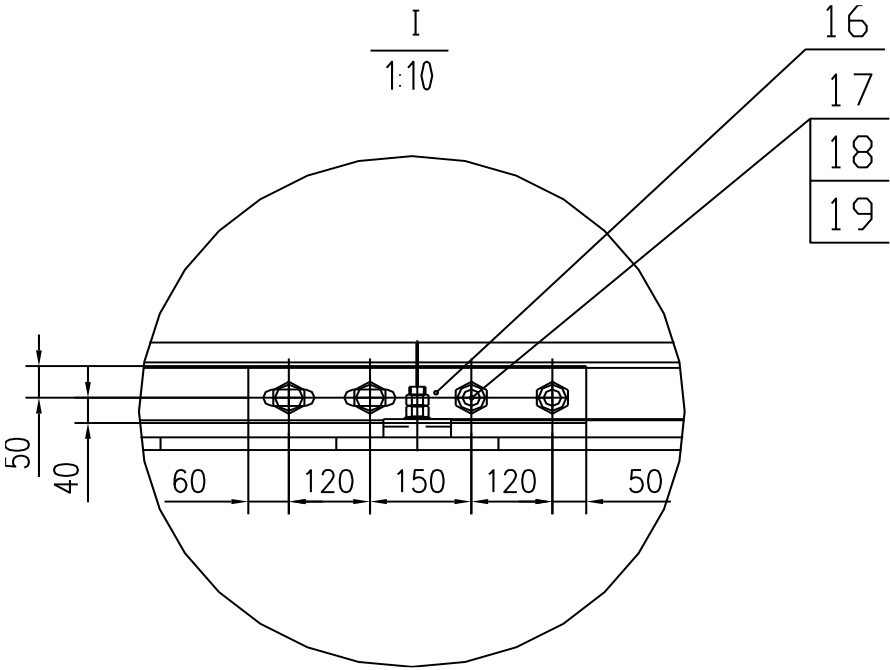
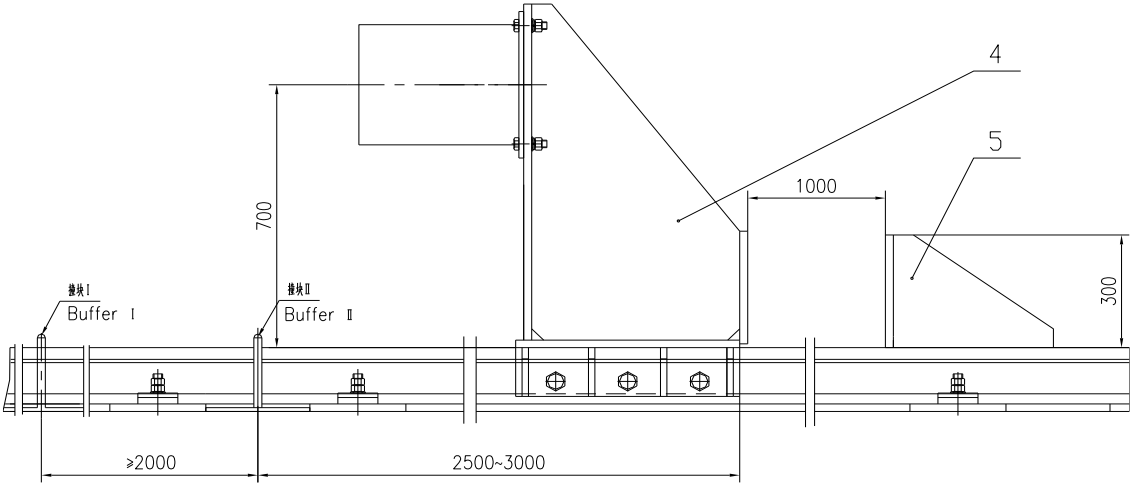
The foundation for the travelling crane is in Fig. 3-19, the specification is as following:

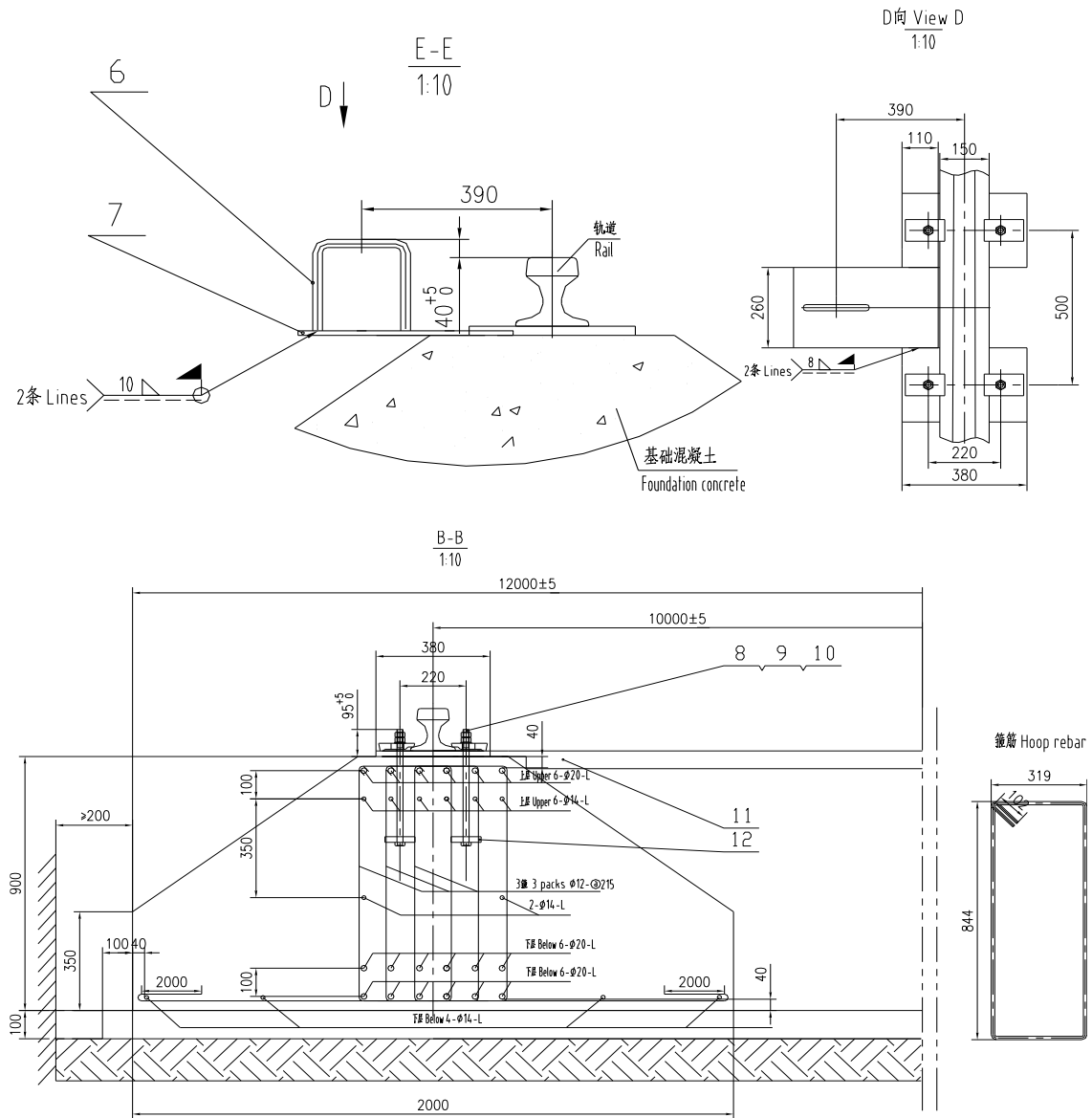
- 1) The road base should be pressed to hard; the bearing capacity is no less than **0.2MPa**.
- 2) Check regularly: the tolerance of the rail distance is **±5mm**, the tolerance at the same fracture level is **5mm**, the vertical rail height tolerance is **1/1000**, the total deviation should be less than **10mm**.
- 3) The juncture of the two rails should be dislocated for 1500m. II
- 4) The two sides of the rail can be equipped by car bumpers according to the actual situation, refer to the figure to set the position limiter, conduct the limiter tests at the construction site to ensure the reliability.
- 5) The rail should be equipped with good grounding measures, the ground resistance should be less than **4 Ohm**.
- 6) The number of the piece in the spare list is calculated based on the **100m** length of the rail.
- 7) The degree of finish of the machining face is $\nabla 50$, the degree of finish of the machining bore is $\nabla 12.5$.
- 8) Length of the electric cable: add **15m** from the fixed point to the furthest of the rail.
- 9) Four sets of anchoring plate can be set to immobilize the tower crane in case of a higher wind speed at the construction site.
- 10) The fabrication and embedding ways of the anchored plate are shown in the drawing sketch, the anchoring position can be determined when the tower crane is out of service, customers can also adopt other ways of anchoring.
- 11) Main reinforcement: HRB335, hooped reinforcement: HPB235.





轨道车挡装配图 Assemble drawing of buffer stop



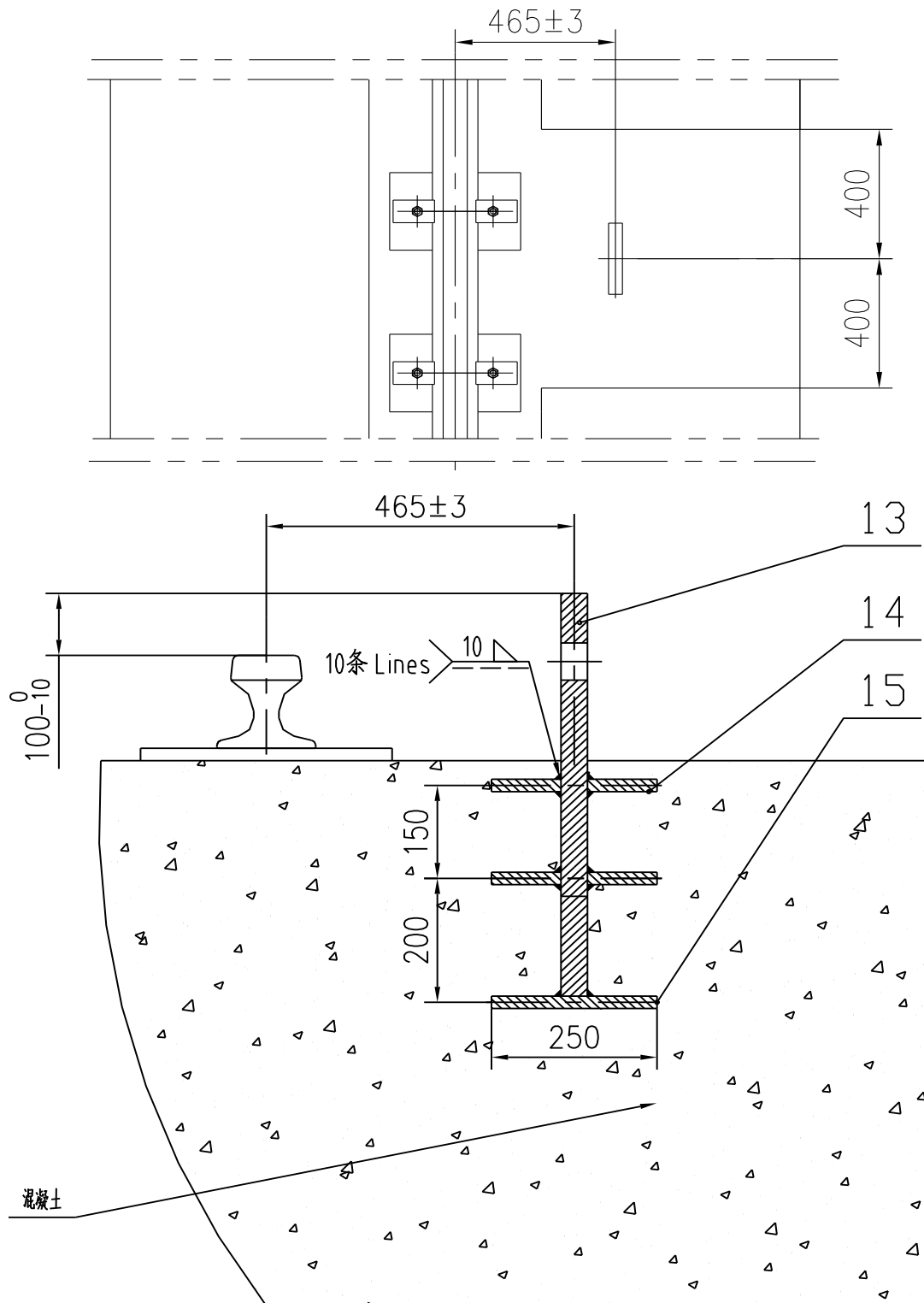


(注: 1. L-视轨道长度而定, 允许接长, 上层筋允许搭接接长, 接长长度 $>30d$, 下层筋允许搭接接长, 搭接长度 $>25d$;
2. 砼基础每30米为一段, 段间间隔20~30mm, 左右砼基础接头至少错开1500mm制作。)

Note 1 The value of L length of the upper and below reinforcement bars equal to the length of the track. It is permitted to weld bars together to add length. The welding length of the upper bars is larger than 30 times diameter, that of the below is larger than 25 times diameter.

2 The concrete foundation should be separate every 30m, the gap clearance is 20-30mm, and the two sides of the foundation's joint should be staggered by 1500mm.

锚固装置图 Anchoring device drawing



注意：在锚固装置处，混凝土截面需如图所示，沿轨道方向长度为800mm。

Notice: The concrete section of anchoring device is shown as the drawing, the length align the railway direction is 800mm.

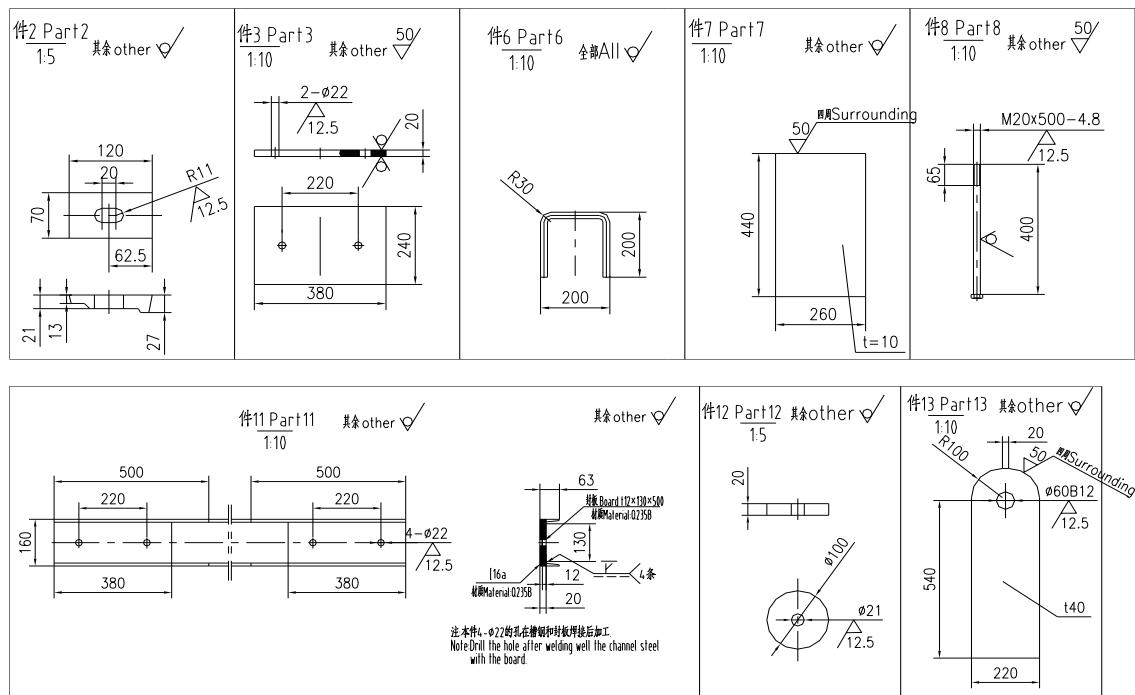
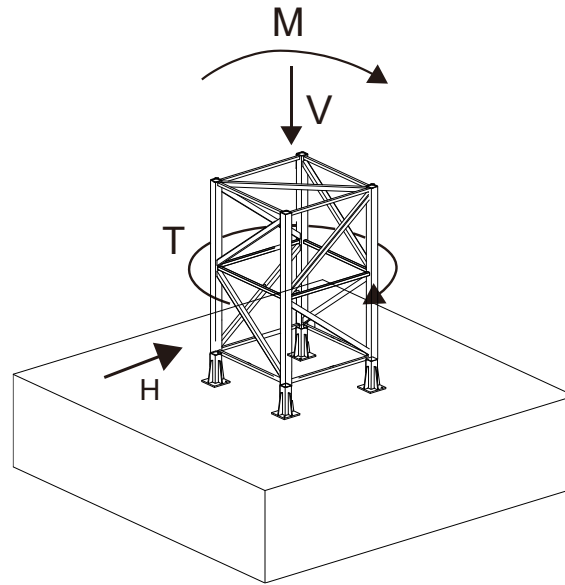


Fig. 3-19 The foundation of travelling chassis tower crane

Table 3-19 Spare part list of travelling chassis tower crane foundation

No.	Description	Specification	Qty	Material	Remarks
1	Steel rail	QU100	16	U71Mn	
2	Pressing plate		804	Q235B	
3	Backing plate	t20-240×380	368	Q235B	
4	Rail-sliding buffer		4	Weldment	
5	Rail-fixed buffer		4	Weldment	
6	Buffer	Φ20	4	Q235B	
7	Bottom plate	t10-260×440	4	Q235B	
8	Embedded bolt	M20-8.8	804		
9	Nut	M20-8	1608		Zn.D
10	Washer	20-200HV	804		
11	Channel steel	[16a-10380	17	Weldment	
12	Backing plate	t20	804	Q235B	
13	Lug		4	Q235B	
14	Plate A	t20-105×220	16	Q235B	
15	Plate B	t20-250×220	4	Q235B	
16	Fish plate		28		
17	Bolt	M24×160-8.8	56		Zn.D
18	Nut	M24-8	112		Zn.D
19	Washer	24-200HV	112		

3.8.5 Load on foundation of outrigger stationary tower crane



T Torque **M** Bending moment **H** Horizontal force **V** Vertical force



- The description of **Quantities of sections** is: quantity of base tower section X42Rb + quantity of tower section X42D.
- The maximum loads appear at the maximum free-standing height in service state. The tower crane with attachment, the moment, horizontal force, torque mainly transmitted to the building by the attachment frame, the load on the foundation no additional.

3.8.5.1 Load on foundation for 80m jib

Table 3-20 Load on foundation for 80m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	13296.5	70.4	3486.1	1470.0
		Out of service	-8108.7	271.5	2817.8	0.0
1+6	40.4	In service	13859.0	74.7	3569.4	1470.0
		Out of service	-8179.5	293.3	2901.1	0.0
1+7	46.1	In service	14480.3	79.1	3652.7	1470.0
		Out of service	-8263.7	315.1	2984.4	0.0
1+8	51.8	In service	15164.9	83.4	3736.0	1470.0
		Out of service	-8362.3	336.9	3067.7	0.0
1+9	57.5	In service	15918.2	87.8	3819.3	1470.0
		Out of service	-8476.6	358.8	3151.0	0.0
1+10	63.2	In service	16746.5	92.2	3902.6	1470.0
		Out of service	8580.9	380.6	3234.3	0.0
1+11	68.9	In service	17657.3	96.5	3985.9	1470.0
		Out of service	10976.2	402.4	3317.6	0.0
1+12	74.6	In service	18659.5	100.9	4069.2	1470.0
		Out of service	13562.0	424.2	3400.9	0.0
1+13	80.3	In service	19763.9	105.2	4152.5	1470.0
		Out of service	16353.9	446.0	3484.2	0.0
1+14	86.0	In service	20983.3	109.6	4235.8	1470.0
		Out of service	19370.8	467.9	3567.5	0.0

3.8.5.2 Load on foundation for 75m jib

Table 3-21 Load on foundation for 75m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	13458.5	70.5	3445.7	1470.0
		Out of service	-8116.7	271.5	2776.1	0.0
1+6	40.4	In service	14021.4	74.8	3529.0	1470.0
		Out of service	-8186.4	293.3	2859.4	0.0
1+7	46.1	In service	14643.0	79.2	3612.3	1470.0
		Out of service	-8269.3	315.1	2942.7	0.0
1+8	51.8	In service	15327.7	83.5	3695.6	1470.0
		Out of service	-8366.4	336.9	3026.0	0.0
1+9	57.5	In service	16080.9	87.9	3778.9	1470.0
		Out of service	-8478.9	358.8	3109.3	0.0
1+10	63.2	In service	16908.8	92.2	3862.2	1470.0
		Out of service	8566.6	380.6	3192.6	0.0
1+11	68.9	In service	17818.8	96.6	3945.5	1470.0
		Out of service	10958.9	402.4	3275.9	0.0
1+12	74.6	In service	18819.8	101.0	4028.8	1470.0
		Out of service	13540.4	424.2	3359.2	0.0
1+13	80.3	In service	19922.2	105.3	4112.1	1470.0
		Out of service	16326.7	446.0	3442.5	0.0
1+14	86.0	In service	21138.9	109.7	4195.4	1470.0
		Out of service	19335.9	467.9	3525.8	0.0

3.8.5.3 Load on foundation for 70m jib

Table 3-22 Load on foundation for 70m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	13978.7	70.7	3372.7	1470.0
		Out of service	-7510.7	271.5	2700.5	0.0
1+6	40.4	In service	14545.1	75.1	3456.0	1470.0
		Out of service	-7573.2	293.3	2783.8	0.0
1+7	46.1	In service	15170.4	79.4	3539.3	1470.0
		Out of service	-7647.6	315.1	2867.1	0.0
1+8	51.8	In service	15859.1	83.8	3622.6	1470.0
		Out of service	-7734.7	336.9	2950.4	0.0
1+9	57.5	In service	16616.4	88.1	3705.9	1470.0
		Out of service	-7835.7	358.8	3033.7	0.0
1+10	63.2	In service	17448.5	92.5	3789.2	1470.0
		Out of service	9197.5	380.6	3117.0	0.0
1+11	68.9	In service	18362.7	96.9	3872.5	1470.0
		Out of service	11595.3	402.4	3200.3	0.0
1+12	74.6	In service	19367.7	101.2	3955.8	1470.0
		Out of service	14181.7	424.2	3283.6	0.0
1+13	80.3	In service	20473.8	105.6	4039.1	1470.0
		Out of service	16971.7	446.0	3366.9	0.0
1+14	86.0	In service	21693.4	109.9	4122.4	1470.0
		Out of service	19983.1	467.9	3450.2	0.0

3.8.5.4 Load on foundation for 65m jib

Table 3-23 Load on foundation for 65m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	13429.0	70.5	3364.9	1470.0
		Out of service	-8061.1	271.5	2693.0	0.0
1+6	40.4	In service	13988.0	74.9	3448.2	1470.0
		Out of service	-8127.9	293.3	2776.3	0.0
1+7	46.1	In service	14604.7	79.2	3531.5	1470.0
		Out of service	-8207.5	315.1	2859.6	0.0
1+8	51.8	In service	15283.4	83.6	3614.8	1470.0
		Out of service	-8300.7	336.9	2942.9	0.0
1+9	57.5	In service	16029.3	87.9	3698.1	1470.0
		Out of service	-8408.7	358.8	3026.2	0.0
1+10	63.2	In service	16848.4	92.3	3781.4	1470.0
		Out of service	8613.8	380.6	3109.5	0.0
1+11	68.9	In service	17747.7	96.6	3864.7	1470.0
		Out of service	11001.4	402.4	3192.8	0.0
1+12	74.6	In service	18735.8	101.0	3948.0	1470.0
		Out of service	13576.1	424.2	3276.1	0.0
1+13	80.3	In service	19822.8	105.4	4031.3	1470.0
		Out of service	16352.7	446.0	3359.4	0.0
1+14	86.0	In service	21020.7	109.7	4114.6	1470.0
		Out of service	19348.7	467.9	3442.7	0.0

3.8.5.5 Load on foundation for 60m jib

Table 3-24 Load on foundation for 60m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	13283.6	70.5	3376.9	1470.0
		Out of service	-8004.2	271.5	2709.9	0.0
1+6	40.4	In service	13841.7	74.9	3460.2	1470.0
		Out of service	-8071.0	293.3	2793.2	0.0
1+7	46.1	In service	14457.3	79.2	3543.5	1470.0
		Out of service	-8150.6	315.1	2876.5	0.0
1+8	51.8	In service	15134.8	83.6	3626.8	1470.0
		Out of service	-8243.8	336.9	2959.8	0.0
1+9	57.5	In service	15879.3	87.9	3710.1	1470.0
		Out of service	-8351.8	358.8	3043.1	0.0
1+10	63.2	In service	16696.8	92.3	3793.4	1470.0
		Out of service	8676.5	380.6	3126.4	0.0
1+11	68.9	In service	17594.4	96.7	3876.7	1470.0
		Out of service	11066.2	402.4	3209.7	0.0
1+12	74.6	In service	18580.7	101.0	3960.0	1470.0
		Out of service	13643.7	424.2	3293.0	0.0
1+13	80.3	In service	19665.6	105.4	4043.3	1470.0
		Out of service	16423.8	446.0	3376.3	0.0
1+14	86.0	In service	20861.3	109.7	4126.6	1470.0
		Out of service	19424.2	467.9	3459.6	0.0

3.8.5.6 Load on foundation for 55m jib

Table 3-25 Load on foundation for 55m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	13104.5	70.4	3416.1	1470.0
		Out of service	-8273.1	271.5	2749.7	0.0
1+6	40.4	In service	13662.0	74.8	3499.4	1470.0
		Out of service	-8343.3	293.3	2833.0	0.0
1+7	46.1	In service	14277.1	79.1	3582.7	1470.0
		Out of service	-8426.9	315.1	2916.3	0.0
1+8	51.8	In service	14954.2	83.5	3666.0	1470.0
		Out of service	-8524.8	336.9	2999.6	0.0
1+9	57.5	In service	15698.5	87.9	3749.3	1470.0
		Out of service	-8638.3	358.8	3082.9	0.0
1+10	63.2	In service	16515.9	92.2	3832.6	1470.0
		Out of service	8397.1	380.6	3166.2	0.0
1+11	68.9	In service	17413.8	96.6	3915.9	1470.0
		Out of service	10784.8	402.4	3249.5	0.0
1+12	74.6	In service	18400.7	100.9	3999.2	1470.0
		Out of service	13360.6	424.2	3332.8	0.0
1+13	80.3	In service	19486.8	105.3	4082.5	1470.0
		Out of service	16139.7	446.0	3416.1	0.0
1+14	86.0	In service	20684.4	109.6	4165.8	1470.0
		Out of service	19140.2	467.9	3499.4	0.0

3.8.5.7 Load on foundation for 50m jib

Table 3-26 Load on foundation for 50m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	13645.8	70.7	3257.0	1470.0
		Out of service	-7372.8	271.5	2586.5	0.0
1+6	40.4	In service	14203.2	75.1	3340.3	1470.0
		Out of service	-7431.2	293.3	2669.8	0.0
1+7	46.1	In service	14817.4	79.4	3423.6	1470.0
		Out of service	-7500.8	315.1	2753.1	0.0
1+8	51.8	In service	15492.9	83.8	3506.9	1470.0
		Out of service	-7582.3	336.9	2836.4	0.0
1+9	57.5	In service	16234.3	88.2	3590.2	1470.0
		Out of service	-7676.7	358.8	2919.7	0.0
1+10	63.2	In service	17047.6	92.5	3673.5	1470.0
		Out of service	9325.7	380.6	3003.0	0.0
1+11	68.9	In service	17939.5	96.9	3756.8	1470.0
		Out of service	11717.6	402.4	3086.3	0.0
1+12	74.6	In service	18918.2	101.2	3840.1	1470.0
		Out of service	14295.1	424.2	3169.6	0.0
1+13	80.3	In service	19993.1	105.6	3923.4	1470.0
		Out of service	17072.6	446.0	3252.9	0.0
1+14	86.0	In service	21175.8	109.9	4006.7	1470.0
		Out of service	20066.8	467.9	3336.2	0.0

3.8.5.8 Load on foundation for 45m jib

Table 3-27 Load on foundation for 45m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	13510.1	70.7	3262.9	1470.0
		Out of service	-7523.0	271.5	2592.0	0.0
1+6	40.4	In service	14066.0	75.0	3346.2	1470.0
		Out of service	-7582.8	293.3	2675.3	0.0
1+7	46.1	In service	14678.7	79.4	3429.5	1470.0
		Out of service	-7654.0	315.1	2758.6	0.0
1+8	51.8	In service	15352.3	83.7	3512.8	1470.0
		Out of service	-7737.3	336.9	2841.9	0.0
1+9	57.5	In service	16091.7	88.1	3596.1	1470.0
		Out of service	-7833.9	358.8	2925.2	0.0
1+10	63.2	In service	16902.7	92.5	3679.4	1470.0
		Out of service	9167.8	380.6	3008.5	0.0
1+11	68.9	In service	17792.0	96.8	3762.7	1470.0
		Out of service	11557.6	402.4	3091.8	0.0
1+12	74.6	In service	18767.8	101.2	3846.0	1470.0
		Out of service	14132.9	424.2	3175.1	0.0
1+13	80.3	In service	19839.6	105.5	3929.3	1470.0
		Out of service	16907.9	446.0	3258.4	0.0
1+14	86.0	In service	21018.9	109.9	4012.6	1470.0
		Out of service	19899.4	467.9	3341.7	0.0

3.8.5.9 Load on foundation for 40m jib

Table 3-28 Load on foundation for 40m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	12895.4	70.5	3342.4	1470.0
		Out of service	-7706.5	271.5	2680.0	0.0
1+6	40.4	In service	13447.7	74.9	3425.7	1470.0
		Out of service	-7770.0	293.3	2763.3	0.0
1+7	46.1	In service	14056.4	79.2	3509.0	1470.0
		Out of service	-7845.7	315.1	2846.6	0.0
1+8	51.8	In service	14725.7	83.6	3592.3	1470.0
		Out of service	-7934.4	336.9	2929.9	0.0
1+9	57.5	In service	15460.5	87.9	3675.6	1470.0
		Out of service	-8037.0	358.8	3013.2	0.0
1+10	63.2	In service	16266.7	92.3	3758.9	1470.0
		Out of service	8987.2	380.6	3096.5	0.0
1+11	68.9	In service	17151.2	96.6	3842.2	1470.0
		Out of service	11380.1	402.4	3179.8	0.0
1+12	74.6	In service	18122.1	101.0	3925.5	1470.0
		Out of service	13960.6	424.2	3263.1	0.0
1+13	80.3	In service	19189.3	105.4	4008.8	1470.0
		Out of service	16743.4	446.0	3346.4	0.0
1+14	86.0	In service	20364.4	109.7	4092.1	1470.0
		Out of service	19746.1	467.9	3429.7	0.0

3.8.5.10 Load on foundation for 35m jib

Table 3-29 Load on foundation for 35m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	13155.7	70.6	3300.5	1470.0
		Out of service	-7464.3	271.5	2636.4	0.0
1+6	40.4	In service	13709.5	75.0	3383.8	1470.0
		Out of service	-7524.8	293.3	2719.7	0.0
1+7	46.1	In service	14319.7	79.3	3467.1	1470.0
		Out of service	-7596.7	315.1	2803.0	0.0
1+8	51.8	In service	14990.6	83.7	3550.4	1470.0
		Out of service	-7681.0	336.9	2886.3	0.0
1+9	57.5	In service	15727.0	88.1	3633.7	1470.0
		Out of service	-7778.7	358.8	2969.6	0.0
1+10	63.2	In service	16534.8	92.4	3717.0	1470.0
		Out of service	9236.7	380.6	3052.9	0.0
1+11	68.9	In service	17420.7	96.8	3800.3	1470.0
		Out of service	11630.7	402.4	3136.2	0.0
1+12	74.6	In service	18392.9	101.1	3883.6	1470.0
		Out of service	14211.5	424.2	3219.5	0.0
1+13	80.3	In service	19461.0	105.5	3966.9	1470.0
		Out of service	16993.8	446.0	3302.8	0.0
1+14	86.0	In service	20636.6	109.8	4050.2	1470.0
		Out of service	19994.8	467.9	3386.1	0.0

3.8.5.11 Load on foundation for 30m jib

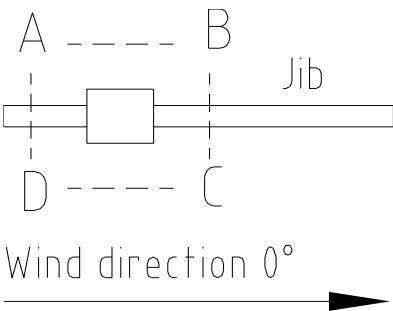
Table 3-30 Load on foundation for 30m jib

Quantities of sections	Working height (m)	Operation status	M (kN·m)	H (kN)	V (kN)	T (kN·m)
1+5	34.7	In service	12680.1	70.5	3202.0	1470.0
		Out of service	-7850.5	271.5	2537.0	0.0
1+6	40.4	In service	13223.7	74.8	3285.3	1470.0
		Out of service	-7911.4	293.3	2620.3	0.0
1+7	46.1	In service	13821.7	79.2	3368.6	1470.0
		Out of service	-7983.9	315.1	2703.6	0.0
1+8	51.8	In service	14478.2	83.6	3451.9	1470.0
		Out of service	-8068.8	336.9	2786.9	0.0
1+9	57.5	In service	15197.7	87.9	3535.2	1470.0
		Out of service	-8167.2	358.8	2870.2	0.0
1+10	63.2	In service	15985.6	92.3	3618.5	1470.0
		Out of service	8814.0	380.6	2953.5	0.0
1+11	68.9	In service	16848.3	96.6	3701.8	1470.0
		Out of service	11194.5	402.4	3036.8	0.0
1+12	74.6	In service	17793.4	101.0	3785.1	1470.0
		Out of service	13758.2	424.2	3120.1	0.0
1+13	80.3	In service	18829.8	105.3	3868.4	1470.0
		Out of service	16518.9	446.0	3203.4	0.0
1+14	86.0	In service	19968.2	109.7	3951.7	1470.0
		Out of service	19492.8	467.9	3286.7	0.0

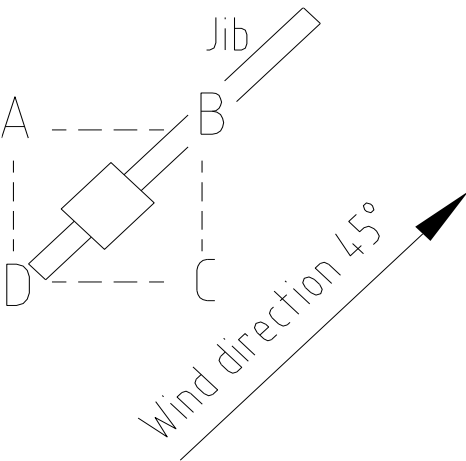
3.8.6 Corner reactions on chassis of travelling chassis tower crane

There are two typical wind states when using the chassis tower crane as figures below. The reactions on chassis outriggers RA, RB, RC, RD are shown in the following tables.

Wind 0° to the chassis



Wind 45° to the chassis



RA Reaction on corner **A** of the chassis
RC Reaction on corner **C** of the chassis

RB Reaction on corner **B** of the chassis
RD Reaction on corner **D** of the chassis



- In the following tables, negative numbers indicate tensions and positive numbers indicate pressures.
- Since tower crane can rotate in 360°, every support point has the possibility to endure any load in the table above.
- The description of **Quantities of sections** is: quantities of tower section X42D.

3.8.6.1 Corner reactions of 80m jib

Table 3-31 Corner reactions of 80m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	303.2	1528.0	1528.0	303.2	915.6	1783.6	915.6	47.7
	/26.0	Out of service	1145.7	351.4	351.4	1145.7	748.6	186.9	748.6	1310.3
3	29.8	In service	304.3	1568.6	1568.6	304.3	936.5	1833.6	936.5	39.3
	/31.7	Out of service	1167.8	371.0	371.0	1167.8	769.4	206.0	769.4	1332.8
4	35.5	In service	303.4	1611.2	1611.2	303.4	957.3	1887.0	957.3	27.6
	/37.4	Out of service	1190.4	390.1	390.1	1190.4	790.2	224.3	790.2	1356.1
5	41.2	In service	300.1	1656.1	1656.1	300.1	978.1	1943.8	978.1	12.4
	/43.1	Out of service	1213.5	408.6	408.6	1213.5	811.0	241.9	811.0	1380.2
6	46.9	In service	368.1	1776.8	1776.8	368.1	1072.4	2077.7	1072.4	67.1
	/48.8	Out of service	1310.7	500.0	500.0	1310.7	905.4	332.1	905.4	1478.6
7	52.6	In service	360.0	1826.5	1826.5	360.0	1093.3	2142.0	1093.3	44.5
	/54.5	Out of service	1335.1	517.3	517.3	1335.1	926.2	347.9	926.2	1504.4
8	58.3	In service	422.7	1952.5	1952.5	422.7	1187.6	2284.0	1187.6	91.2
	/60.2	Out of service	1433.6	607.4	607.4	1433.6	1020.5	436.3	1020.5	1604.7
9	64.0	In service	409.0	2007.8	2007.8	409.0	1208.4	2356.9	1208.4	59.9
	/65.9	Out of service	1459.3	623.4	623.4	1459.3	1041.3	450.2	1041.3	1632.5
10	69.7	In service	465.6	2139.8	2139.8	465.6	1302.7	2508.2	1302.7	97.2
	/71.6	Out of service	1559.3	712.0	712.0	1559.3	1135.7	536.5	1135.7	1734.8
11	75.4	In service	518.8	2275.3	2275.3	518.8	1397.1	2664.8	1397.1	129.3
	/77.3	Out of service	1660.2	799.8	799.8	1660.2	1230.0	2180.0	1230.0	280.0

3.8.6.2 Corner reactions of 75m jib

Table 3-32 Corner reactions of 75m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	361.5	1602.4	1602.4	361.5	982.0	1861.3	982.0	102.7
	/26.0	Out of service	1212.3	416.9	416.9	1212.3	814.6	252.1	814.6	1377.0
3	29.8	In service	362.6	1643.0	1643.0	362.6	1002.8	1911.4	1002.8	94.2
	/31.7	Out of service	1234.3	436.5	436.5	1234.3	835.4	271.2	835.4	1399.5
4	35.5	In service	361.6	1685.7	1685.7	361.6	1023.6	1964.8	1023.6	82.5
	/37.4	Out of service	1256.9	455.6	455.6	1256.9	856.2	289.6	856.2	1422.8
5	41.2	In service	358.4	1730.6	1730.6	358.4	1044.5	2021.6	1044.5	67.3
	/43.1	Out of service	1280.0	474.1	474.1	1280.0	877.0	307.2	877.0	1446.8
6	46.9	In service	426.3	1851.3	1851.3	426.3	1138.8	2155.6	1138.8	122.0
	/48.8	Out of service	1377.1	565.6	565.6	1377.1	971.4	397.5	971.4	1545.2
7	52.6	In service	418.2	1901.1	1901.1	418.2	1159.6	2219.9	1159.6	99.3
	/54.5	Out of service	1401.4	583.0	583.0	1401.4	992.2	413.5	992.2	1570.9
8	58.3	In service	480.9	2027.0	2027.0	480.9	1253.9	2361.9	1253.9	145.9
	/60.2	Out of service	1499.9	673.2	673.2	1499.9	1086.5	502.0	1086.5	1671.1
9	64.0	In service	467.1	2082.4	2082.4	467.1	1274.8	2434.9	1274.8	114.6
	/65.9	Out of service	1525.5	689.2	689.2	1525.5	1107.3	515.9	1107.3	1698.8
10	69.7	In service	523.8	2214.4	2214.4	523.8	1369.1	2586.1	1369.1	152.0
	/71.6	Out of service	1625.5	777.9	777.9	1625.5	1201.7	602.3	1201.7	1801.0
11	75.4	In service	577.0	2349.8	2349.8	577.0	1463.4	2742.7	1463.4	184.1
	/77.3	Out of service	1726.2	865.8	865.8	1726.2	1296.0	2245.0	1296.0	347.0

3.8.6.3 Corner reactions of 70m jib

Table 3-33 Corner reactions of 70m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	317.6	1609.8	1609.8	317.6	963.7	1879.3	963.7	48.2
	/26.0	Out of service	1163.9	427.4	427.4	1163.9	795.7	274.9	795.7	1316.4
3	29.8	In service	318.6	1650.5	1650.5	318.6	984.5	1929.5	984.5	39.6
	/31.7	Out of service	1185.8	447.1	447.1	1185.8	816.5	294.2	816.5	1338.8
4	35.5	In service	317.5	1693.3	1693.3	317.5	1005.4	1983.1	1005.4	27.6
	/37.4	Out of service	1208.2	466.4	466.4	1208.2	837.3	312.8	837.3	1361.8
5	41.2	In service	314.1	1738.3	1738.3	314.1	1026.2	2040.1	1026.2	12.2
	/43.1	Out of service	1231.0	485.2	485.2	1231.0	858.1	330.8	858.1	1385.5
6	46.9	In service	381.8	1859.2	1859.2	381.8	1120.5	2174.3	1120.5	66.7
	/48.8	Out of service	1327.9	577.0	577.0	1327.9	952.5	421.5	952.5	1483.4
7	52.6	In service	373.5	1909.1	1909.1	373.5	1141.3	2238.9	1141.3	43.7
	/54.5	Out of service	1351.9	594.7	594.7	1351.9	973.3	437.9	973.3	1508.7
8	58.3	In service	436.1	2035.3	2035.3	436.1	1235.7	2381.2	1235.7	90.1
	/60.2	Out of service	1449.9	685.3	685.3	1449.9	1067.6	527.0	1067.6	1608.2
9	64.0	In service	422.1	2090.8	2090.8	422.1	1256.5	2454.4	1256.5	58.6
	/65.9	Out of service	1475.0	701.8	701.8	1475.0	1088.4	541.7	1088.4	1635.2
10	69.7	In service	478.6	2223.1	2223.1	478.6	1350.8	2606.0	1350.8	95.7
	/71.6	Out of service	1574.4	791.1	791.1	1574.4	1182.8	628.9	1182.8	1736.6
11	75.4	In service	531.5	2358.7	2358.7	531.5	1445.1	2762.8	1445.1	127.5
	/77.3	Out of service	664.6	1889.6	1889.6	664.6	1277.1	2270.7	1277.1	283.5

3.8.6.4 Corner reactions of 65m jib

Table 3-34 Corner reactions of 65m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	342.3	1581.2	1581.2	342.3	961.8	1839.6	961.8	83.9
	/26.0	Out of service	1189.1	398.5	398.5	1189.1	793.8	234.8	793.8	1352.8
3	29.8	In service	343.5	1621.7	1621.7	343.5	982.6	1889.6	982.6	75.5
	/31.7	Out of service	1211.0	418.2	418.2	1211.0	814.6	254.0	814.6	1375.2
4	35.5	In service	342.5	1664.3	1664.3	342.5	1003.4	1942.9	1003.4	63.9
	/37.4	Out of service	1233.5	437.4	437.4	1233.5	835.4	272.5	835.4	1398.4
5	41.2	In service	339.4	1709.0	1709.0	339.4	1024.2	1999.6	1024.2	48.9
	/43.1	Out of service	1256.5	456.0	456.0	1256.5	856.3	290.2	856.3	1422.3
6	46.9	In service	407.5	1829.6	1829.6	407.5	1118.6	2133.3	1118.6	103.8
	/48.8	Out of service	1353.6	547.6	547.6	1353.6	950.6	380.7	950.6	1520.5
7	52.6	In service	399.6	1879.2	1879.2	399.6	1139.4	2197.4	1139.4	81.4
	/54.5	Out of service	1377.7	565.1	565.1	1377.7	971.4	396.8	971.4	1546.0
8	58.3	In service	462.5	2004.9	2004.9	462.5	1233.7	2339.1	1233.7	128.4
	/60.2	Out of service	1476.0	655.5	655.5	1476.0	1065.7	485.5	1065.7	1646.0
9	64.0	In service	449.1	2060.0	2060.0	449.1	1254.5	2411.6	1254.5	97.5
	/65.9	Out of service	1501.5	671.7	671.7	1501.5	1086.6	499.8	1086.6	1673.3
10	69.7	In service	506.1	2191.6	2191.6	506.1	1348.9	2562.3	1348.9	135.4
	/71.6	Out of service	1601.2	760.6	760.6	1601.2	1180.9	586.5	1180.9	1775.3
11	75.4	In service	559.7	2326.7	2326.7	559.7	1443.2	2718.3	1443.2	168.1
	/77.3	Out of service	1701.7	848.7	848.7	1701.7	1275.2	2227.5	1275.2	322.9

3.8.6.5 Corner reactions of 60m jib

Table 3-35 Corner reactions of 60m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	352.5	1577.0	1577.0	352.5	964.8	1832.5	964.8	97.0
	/26.0	Out of service	1190.4	405.6	405.6	1190.4	798.0	243.1	798.0	1353.0
3	29.8	In service	353.7	1617.5	1617.5	353.7	985.6	1882.5	985.6	88.7
	/31.7	Out of service	1212.4	425.3	425.3	1212.4	818.8	262.3	818.8	1375.4
4	35.5	In service	352.7	1660.1	1660.1	352.7	1006.4	1935.7	1006.4	77.1
	/37.4	Out of service	1234.9	444.5	444.5	1234.9	839.7	280.7	839.7	1398.6
5	41.2	In service	349.6	1704.8	1704.8	349.6	1027.2	1992.4	1027.2	62.1
	/43.1	Out of service	1257.9	463.1	463.1	1257.9	860.5	298.5	860.5	1422.5
6	46.9	In service	417.7	1825.4	1825.4	417.7	1121.6	2126.1	1121.6	117.0
	/48.8	Out of service	1355.0	554.7	554.7	1355.0	954.8	389.0	954.8	1520.7
7	52.6	In service	409.9	1874.9	1874.9	409.9	1142.4	2190.1	1142.4	94.7
	/54.5	Out of service	1379.1	572.2	572.2	1379.1	975.6	405.1	975.6	1546.2
8	58.3	In service	472.9	2000.5	2000.5	472.9	1236.7	2331.6	1236.7	141.8
	/60.2	Out of service	1477.4	662.6	662.6	1477.4	1070.0	493.8	1070.0	1646.2
9	64.0	In service	459.5	2055.5	2055.5	459.5	1257.5	2404.1	1257.5	111.0
	/65.9	Out of service	1502.9	678.7	678.7	1502.9	1090.8	508.0	1090.8	1673.5
10	69.7	In service	516.6	2187.1	2187.1	516.6	1351.9	2554.7	1351.9	149.0
	/71.6	Out of service	1602.6	767.7	767.7	1602.6	1185.1	594.8	1185.1	1775.5
11	75.4	In service	570.3	2322.1	2322.1	570.3	1446.2	2710.6	1446.2	181.8
	/77.3	Out of service	1703.1	855.8	855.8	1703.1	1279.4	2236.2	1279.4	322.7

3.8.6.6 Corner reactions of 55m jib

Table 3-36 Corner reactions of 55m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	371.2	1577.9	1577.9	371.2	974.6	1829.7	974.6	119.4
	/26.0	Out of service	1213.4	402.5	402.5	1213.4	808.0	234.5	808.0	1381.4
3	29.8	In service	372.4	1618.4	1618.4	372.4	995.4	1879.7	995.4	111.1
	/31.7	Out of service	1235.5	422.1	422.1	1235.5	828.8	253.6	828.8	1403.9
4	35.5	In service	371.5	1660.9	1660.9	371.5	1016.2	1932.9	1016.2	99.5
	/37.4	Out of service	1258.0	441.2	441.2	1258.0	849.6	272.0	849.6	1427.2
5	41.2	In service	368.4	1705.7	1705.7	368.4	1037.0	1989.5	1037.0	84.6
	/43.1	Out of service	1281.1	459.7	459.7	1281.1	870.4	289.6	870.4	1451.2
6	46.9	In service	436.6	1826.2	1826.2	436.6	1131.4	2123.1	1131.4	139.6
	/48.8	Out of service	1378.3	551.2	551.2	1378.3	964.8	379.9	964.8	1549.6
7	52.6	In service	428.7	1875.7	1875.7	428.7	1152.2	2187.1	1152.2	117.3
	/54.5	Out of service	1402.6	568.5	568.5	1402.6	985.6	395.8	985.6	1575.4
8	58.3	In service	491.7	2001.3	2001.3	491.7	1246.5	2328.6	1246.5	164.4
	/60.2	Out of service	1501.1	658.7	658.7	1501.1	1079.9	484.2	1079.9	1675.6
9	64.0	In service	478.4	2056.3	2056.3	478.4	1267.3	2401.1	1267.3	133.6
	/65.9	Out of service	1526.8	674.6	674.6	1526.8	1100.7	498.1	1100.7	1703.3
10	69.7	In service	535.5	2187.8	2187.8	535.5	1361.7	2551.7	1361.7	171.6
	/71.6	Out of service	1626.8	763.3	763.3	1626.8	1195.1	584.4	1195.1	1805.7
11	75.4	In service	589.2	2322.8	2322.8	589.2	1456.0	2707.5	1456.0	204.5
	/77.3	Out of service	1727.6	851.1	851.1	1727.6	1289.4	2226.4	1289.4	352.4

3.8.6.7 Corner reactions of 50m jib

Table 3-37 Corner reactions of 50m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	304.4	1565.2	1565.2	304.4	934.8	1828.2	934.8	41.4
	/26.0	Out of service	1129.0	405.3	405.3	1129.0	767.2	255.5	767.2	1278.9
3	29.8	In service	305.5	1605.8	1605.8	305.5	955.6	1878.3	955.6	32.9
	/31.7	Out of service	1150.8	425.1	425.1	1150.8	788.0	274.9	788.0	1301.1
4	35.5	In service	304.5	1648.4	1648.4	304.5	976.5	1931.6	976.5	21.3
	/37.4	Out of service	1173.1	444.5	444.5	1173.1	808.8	293.6	808.8	1324.0
5	41.2	In service	301.4	1693.1	1693.1	301.4	997.3	1988.2	997.3	6.3
	/43.1	Out of service	1195.8	463.5	463.5	1195.8	829.6	311.8	829.6	1347.5
6	46.9	In service	369.5	1813.7	1813.7	369.5	1091.6	2121.9	1091.6	61.3
	/48.8	Out of service	1292.5	555.4	555.4	1292.5	924.0	402.7	924.0	1445.2
7	52.6	In service	361.7	1863.1	1863.1	361.7	1112.4	2185.9	1112.4	39.0
	/54.5	Out of service	1316.3	573.3	573.3	1316.3	944.8	419.4	944.8	1470.1
8	58.3	In service	424.8	1988.7	1988.7	424.8	1206.8	2327.3	1206.8	86.2
	/60.2	Out of service	1414.1	664.2	664.2	1414.1	1039.1	508.9	1039.1	1569.4
9	64.0	In service	411.5	2043.6	2043.6	411.5	1227.6	2399.6	1227.6	55.5
	/65.9	Out of service	1438.9	680.9	680.9	1438.9	1059.9	523.9	1059.9	1595.9
10	69.7	In service	468.7	2175.1	2175.1	468.7	1321.9	2550.1	1321.9	93.7
	/71.6	Out of service	1538.0	770.6	770.6	1538.0	1154.3	611.6	1154.3	1696.9
11	75.4	In service	522.6	2309.8	2309.8	522.6	1416.2	2705.6	1416.2	126.8
	/77.3	Out of service	629.6	1867.6	1867.6	629.6	1248.6	2251.2	1248.6	245.9

3.8.6.8 Corner reactions of 45m jib

Table 3-38 Corner reactions of 45m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	312.4	1560.1	1560.1	312.4	936.3	1820.3	936.3	52.2
	/26.0	Out of service	1137.7	399.4	399.4	1137.7	768.5	246.4	768.5	1290.7
3	29.8	In service	313.6	1600.6	1600.6	313.6	957.1	1870.3	957.1	43.8
	/31.7	Out of service	1159.6	419.2	419.2	1159.6	789.4	265.8	789.4	1312.9
4	35.5	In service	312.7	1643.1	1643.1	312.7	977.9	1923.6	977.9	32.3
	/37.4	Out of service	1181.9	438.5	438.5	1181.9	810.2	284.5	810.2	1335.8
5	41.2	In service	309.6	1687.8	1687.8	309.6	998.7	1980.1	998.7	17.3
	/43.1	Out of service	1204.7	457.4	457.4	1204.7	831.0	302.6	831.0	1359.4
6	46.9	In service	377.8	1808.3	1808.3	377.8	1093.1	2113.7	1093.1	72.4
	/48.8	Out of service	1301.4	549.3	549.3	1301.4	925.3	393.5	925.3	1457.2
7	52.6	In service	370.0	1857.7	1857.7	370.0	1113.9	2177.6	1113.9	50.2
	/54.5	Out of service	1325.2	567.1	567.1	1325.2	946.2	410.1	946.2	1482.2
8	58.3	In service	433.2	1983.2	1983.2	433.2	1208.2	2318.9	1208.2	97.5
	/60.2	Out of service	1423.1	657.9	657.9	1423.1	1040.5	499.4	1040.5	1581.6
9	64.0	In service	420.0	2038.0	2038.0	420.0	1229.0	2391.1	1229.0	67.0
	/65.9	Out of service	1448.1	674.6	674.6	1448.1	1061.3	514.4	1061.3	1608.3
10	69.7	In service	477.3	2169.4	2169.4	477.3	1323.4	2541.4	1323.4	105.3
	/71.6	Out of service	1547.2	764.1	764.1	1547.2	1155.6	601.9	1155.6	1709.4
11	75.4	In service	531.3	2304.0	2304.0	531.3	1417.7	2696.8	1417.7	138.6
	/77.3	Out of service	638.8	1861.1	1861.1	638.8	1250.0	2241.5	1250.0	258.5

3.8.6.9 Corner reactions of 40m jib

Table 3-39 Corner reactions of 40m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	362.6	1549.6	1549.6	362.6	956.1	1797.3	956.1	114.9
	/26.0	Out of service	1168.5	412.6	412.6	1168.5	790.5	256.1	790.5	1325.0
3	29.8	In service	363.9	1590.0	1590.0	363.9	977.0	1847.2	977.0	106.7
	/31.7	Out of service	1190.4	432.4	432.4	1190.4	811.4	275.4	811.4	1347.4
4	35.5	In service	363.1	1632.5	1632.5	363.1	997.8	1900.3	997.8	95.3
	/37.4	Out of service	1212.8	451.6	451.6	1212.8	832.2	294.0	832.2	1370.4
5	41.2	In service	360.2	1677.0	1677.0	360.2	1018.6	1956.6	1018.6	80.6
	/43.1	Out of service	1235.7	470.4	470.4	1235.7	853.0	311.9	853.0	1394.2
6	46.9	In service	428.5	1797.3	1797.3	428.5	1112.9	2090.0	1112.9	135.9
	/48.8	Out of service	1332.6	562.1	562.1	1332.6	947.3	402.5	947.3	1492.2
7	52.6	In service	420.9	1846.6	1846.6	420.9	1133.8	2153.6	1133.8	113.9
	/54.5	Out of service	1356.6	579.8	579.8	1356.6	968.2	418.9	968.2	1517.5
8	58.3	In service	484.3	1971.9	1971.9	484.3	1228.1	2294.7	1228.1	161.5
	/60.2	Out of service	1454.7	670.3	670.3	1454.7	1062.5	507.9	1062.5	1617.1
9	64.0	In service	471.3	2026.5	2026.5	471.3	1248.9	2366.5	1248.9	131.3
	/65.9	Out of service	1479.9	686.7	686.7	1479.9	1083.3	522.4	1083.3	1644.2
10	69.7	In service	528.9	2157.6	2157.6	528.9	1343.2	2516.5	1343.2	170.0
	/71.6	Out of service	1579.4	775.9	775.9	1579.4	1177.6	609.5	1177.6	1745.8
11	75.4	In service	583.1	2292.0	2292.0	583.1	1437.6	2671.5	1437.6	203.6
	/77.3	Out of service	1679.6	864.4	864.4	1679.6	1272.0	2250.7	1272.0	293.2

3.8.6.10 Corner reactions of 35m jib

Table 3-40 Corner reactions of 35m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	339.3	1552.0	1552.0	339.3	945.7	1805.1	945.7	86.3
	/26.0	Out of service	1145.8	413.5	413.5	1145.8	779.6	261.8	779.6	1297.5
3	29.8	In service	340.5	1592.5	1592.5	340.5	966.5	1855.0	966.5	78.0
	/31.7	Out of service	1167.7	433.3	433.3	1167.7	800.5	281.2	800.5	1319.8
4	35.5	In service	339.7	1635.0	1635.0	339.7	987.3	1908.1	987.3	66.5
	/37.4	Out of service	1190.0	452.6	452.6	1190.0	821.3	299.9	821.3	1342.7
5	41.2	In service	336.7	1679.6	1679.6	336.7	1008.2	1964.6	1008.2	51.7
	/43.1	Out of service	1212.8	471.4	471.4	1212.8	842.1	317.9	842.1	1366.3
6	46.9	In service	405.0	1800.0	1800.0	405.0	1102.5	2098.1	1102.5	106.9
	/48.8	Out of service	1309.6	563.3	563.3	1309.6	936.4	408.7	936.4	1464.2
7	52.6	In service	397.3	1849.3	1849.3	397.3	1123.3	2161.8	1123.3	84.8
	/54.5	Out of service	1333.4	581.1	581.1	1333.4	957.3	425.3	957.3	1489.2
8	58.3	In service	460.6	1974.7	1974.7	460.6	1217.6	2302.9	1217.6	132.3
	/60.2	Out of service	1431.3	671.9	671.9	1431.3	1051.6	514.6	1051.6	1588.6
9	64.0	In service	447.6	2029.3	2029.3	447.6	1238.5	2374.9	1238.5	102.0
	/65.9	Out of service	1456.4	688.5	688.5	1456.4	1072.4	529.5	1072.4	1615.4
10	69.7	In service	505.0	2160.5	2160.5	505.0	1332.8	2525.0	1332.8	140.5
	/71.6	Out of service	1555.5	777.9	777.9	1555.5	1166.7	616.9	1166.7	1716.6
11	75.4	In service	559.2	2295.0	2295.0	559.2	1427.1	2680.1	1427.1	174.1
	/77.3	Out of service	646.6	1875.6	1875.6	646.6	1261.1	2257.4	1261.1	264.7

3.8.6.11 Corner reactions of 30m jib

Table 3-41 Corner reactions of 30m jib

Quantities of sections	Working height (m)	Operation status	Wind 0°(kN)				Wind 45°(kN)			
			RA	RB	RC	RD	RA	RB	RC	RD
2	24.1	In service	337.3	1504.7	1504.7	337.3	921.0	1748.4	921.0	93.7
	/26.0	Out of service	1140.2	369.3	369.3	1140.2	754.8	209.7	754.8	1299.9
3	29.8	In service	338.7	1545.0	1545.0	338.7	941.9	1798.1	941.9	85.7
	/31.7	Out of service	1162.1	389.1	389.1	1162.1	775.6	229.0	775.6	1322.2
4	35.5	In service	338.2	1587.2	1587.2	338.2	962.7	1850.8	962.7	74.6
	/37.4	Out of service	1184.4	408.4	408.4	1184.4	796.4	247.7	796.4	1345.1
5	41.2	In service	335.5	1631.5	1631.5	335.5	983.5	1906.8	983.5	60.2
	/43.1	Out of service	1207.2	427.3	427.3	1207.2	817.3	265.8	817.3	1368.7
6	46.9	In service	404.2	1751.5	1751.5	404.2	1077.8	2039.7	1077.8	116.0
	/48.8	Out of service	1304.0	519.1	519.1	1304.0	911.6	356.6	911.6	1466.6
7	52.6	In service	397.0	1800.3	1800.3	397.0	1098.7	2102.7	1098.7	94.7
	/54.5	Out of service	1327.9	536.9	536.9	1327.9	932.4	373.1	932.4	1491.7
8	58.3	In service	460.9	1925.1	1925.1	460.9	1193.0	2243.0	1193.0	143.0
	/60.2	Out of service	1425.8	627.6	627.6	1425.8	1026.7	462.3	1026.7	1591.1
9	64.0	In service	448.6	1979.0	1979.0	448.6	1213.8	2313.9	1213.8	113.7
	/65.9	Out of service	1450.9	644.2	644.2	1450.9	1047.6	477.2	1047.6	1617.9
10	69.7	In service	506.9	2109.4	2109.4	506.9	1308.1	2462.8	1308.1	153.4
	/71.6	Out of service	1550.1	733.7	733.7	1550.1	1141.9	564.6	1141.9	1719.2
11	75.4	In service	562.0	2242.9	2242.9	562.0	1402.5	2616.6	1402.5	188.3
	/77.3	Out of service	1650.1	822.3	822.3	1650.1	1236.2	2202.7	1236.2	269.7

3.9 Power supply

3.9.1 Definition

Nominal power

This is the sum of the nominal powers (operating powers consumed simultaneously by the three movements) of:

- hoisting mechanism
- trolley mechanism
- slewing mechanism

Starting power

This is the sum of the powers consumed temporarily by these same three movements under the following conditions:

- starting power of the mechanism with the highest current consumption (in general: the hoisting mechanism)
- nominal power of the two other mechanisms

Nominal current intensity

Results from the nominal power

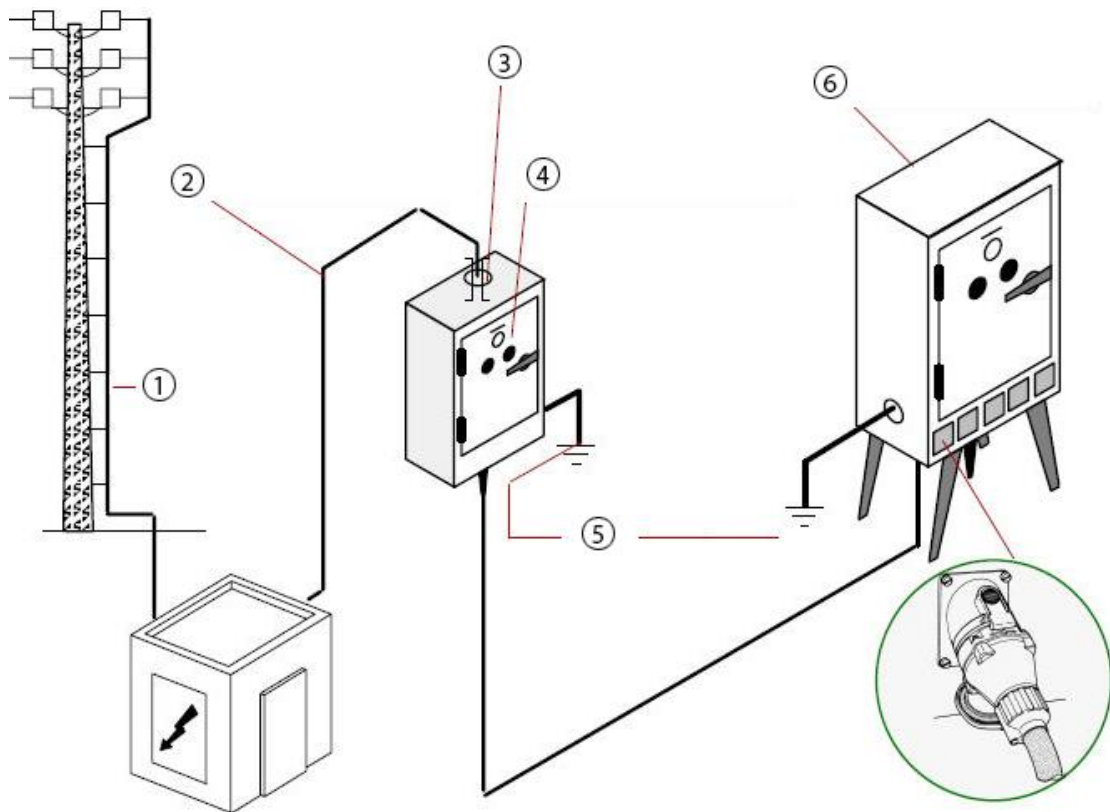
Starting current intensity

Results from the starting power

3.9.2 Current supply

3.9.2.1 Characteristic of the site power supply

The electrical equipment of the tower crane must comply with relevant regulations to ensure normal operation of equipment and safety of personnel. The equipment must conform to the current standards of the country where it is located. There is an example of overall current supply arrangement below:



- | | |
|--------------------------|--------------------------|
| (1) Power grid | (2) Counted by voltmeter |
| (3) Enforced isolation | (4) Auto-break device |
| (5) Local grounding plug | (6) Distributing box |

The protection of power grid should include:

A distributing box after the voltage-meter, which has built-in automatic breakers and leakage protection device, which is adjustable, to turn off the circuit.

The distributing box, included in tower crane electrical system should configure multistage switch. The switch can be locked at off-location, in order to maintenance or dealing with accident.



All the power cables must keep away from the communication cables!

3.9.2.2 Grounding

Installing grounding wire should accord with current standards, which requires:

- Metal parts' grounding;
- Track's grounding.
- All the grounding parts should be connected, the connection of the grounding circuit should be checking in period.
- The grounding wire is yellow-green, which connects the "grounding" terminal of metal parts to grounding plugs or grid. The method of grounding sees also in relative introductions of mechanism parts, the grounding resistance should not more than 4 Ohms.



- It's forbidden to replace the grounding wires with neutral wires.
- The grounding wires should be conducted, and isolated from any breaker.

3.9.2.3 Power source cable

The power source cable includes 3 phase conductors, 1 neutral conductor, and 1 grounding conductor which is yellow-green. The grounding line should be fixed on the reserved terminal.

Accident could be caused by any source line's damage, so it's recommended to dispose the source lines in appropriate way to ensure that no damage on insulation of the lines.

3.9.2.4 The requirement of tower crane's source

A. Power

The power of the source is determined by capacity of all mechanism, speed controlling manner and working condition (With load or without load start-up).

B. Characteristic of supply voltage

- According to our technical specification, the supply voltage at the crane switch must be: 50 Hz in Europe

maximum voltage without load: 400 V + 6% (i.e. between 400 V and 420 V)

minimum voltage with load: 400 V - 10% (i.e. between 360 V and 400 V)

- The minimum voltage depends on:

the voltage supplied by the supply source with load,

the voltage drops in the supply cable,

the cable cross- section (the thicker the cable is, the lower the voltage drop will be),

the type of the cable (aluminum or copper),

the cable length between the supply source and the crane switch,

the current surge when starting the crane.

Choosing a cable cross-section

As a first approach, a cable cross- section is accepted if the current density which is passing through is lower than 4 amperes per mm^2 .

Example: Current intensity of the crane 50 amperes:

$$\text{Minimum cable cross-section} = \frac{50}{4} = 12.5 \text{ mm}^2$$

- Take the cable cross-section (in the "Cable cross-section" row of the table below) which is equal or slightly bigger, i.e. **3 x 16 mm² + N (neutral)+T (earth)**

Copper Cables		
No.	Cable cross-section	Voltage drop per kilometer per ampere, V/(km·A) (cos Φ= 0,8)
1	3 x 6 mm ² + N+T	6.00
2	3 x 10 mm ² + N+T	3.50
3	3 x 16 mm ² + N+T	2.20
4	3 x 25 mm ² + N+T	1.50
5	3 x 35 mm ² + N+T	1.10
6	3 x 50 mm ² + N+T	0.77
7	3 x 70 mm ² + N+T	0.57
8	3 x 95 mm ² + N+T	0.46
9	3 x 120 mm ² + N+T	0.38
10	3 x 150 mm ² + N+T	0.32
11	3 x 185 mm ² + N+T	0.28
12	3 x 240 mm ² + N+T	0.23

C. Determining the coefficient of the voltage drop

- Take the coefficient of the voltage drop in the table above depending on the cable cross-section calculated before.

Calculation of the maximum supply cable length for a known cable cross-section

Data:

- Supply source: 50 Hz
420 V with the crane without load
390 V with the crane with load
- Crane: Value of the permissible minimum voltage 360 V with load.

The voltage drop must not exceed 390 V - 360 V = 30 V in the cable of length L.

The formula will be:

$$\text{Maximum length} = \frac{\text{permissible voltage drop}}{\text{coeff.} \times I_d}$$

with:

30 V: permissible voltage dropping,

Voltage dropping: depending on the cable cross-section,

I_d: starting current intensity.

Example:

1. For a cable of 3 x 16 mm² + **N** (neutral)+**T** (earth), the coefficient is of 2,2
2. With a starting current intensity of 190A

it is obtained:

$$\frac{30}{2.2 \times 190} = \frac{30}{418} = 0,072 \text{ km, i. e. } 72 \text{ m}$$

0. In order to obtain a more considerable length, a bigger cable cross- section must be taken (with a lower coefficient).

Example:

- For a cable of 3 x 35 mm² + **N** (neutral)+**T** (earth), the coefficient is of 1,1
- With the same starting current intensity of 190 A

it is obtained:

$$\frac{30}{1.1 \times 190} = \frac{30}{209} = 0,144 \text{ km, i. e. } 144 \text{ m}$$

The power voltage drop can't be over 5%, for the T1200-64Q:

It has 3 cables of YC3×16+2×6, a cable of YC1×120, a cable of VBR120(Yellow & Green).

All the cables' length can't be over 227m.

3.9.2.5 Connecting the motors

Before connecting the crane, check the connection in the terminal boxes; carry out the same operation when replacing a motor.

A. Identification of the motors

On the rating plate are indicated the supply voltage, the frequency of this voltage followed by the sign for star or delta connection depending on the connection to be carried out for this voltage, or there are two voltages indicated of which the lowest one corresponds to delta connection.

Furthermore, in order to call the servicemen's attention to the motor 400 V in delta connection, a plate is riveted on the motor stator.

B. Checking the direction of rotation of the motors

Having connected the crane to the mains, operate a "Lowering" pulse on the control unit or with the jib retaining winch for GTMR and HDT cranes which are equipped with a LVF hoist winch; check that the rope slackens.

- If yes, the direction of rotation is correct
- If not, interchange two wires in the plug or in the circuit breaker of the mains supply.

4 ERECTION/ADJUSTMENT/DISMANTLING

4.1 Foreword

This part comprises the instructions allowing the fitter in charge with the crane installation on the site to:

- erect the crane,
- carry out the adjustments,
- dismantle the crane.

According to the method applicable to the configuration(s) defined on the order.

The erection and dismantling operations of the crane must be **ABSOLUTELY CARRIED OUT** in the indicated order.

This part does not comprise instructions concerning special operations.

These last operations can only be carried out by the constructor or his representative.

This part cannot be separated from the whole document: it can only be used after reading the **Chapter 2 <SAFETY INSTRUCTION>** and **Chapter 3 <TECHNICAL DATA OF CRANE AND SITE>**.

4.2 Note on safety regarding erection

The operating mode defined below allows fast and safe assembling of the crane up to its climbing or working position (complete erection by means of a mobile crane).

The erection operations need an auxiliary lifting equipment of which the characteristics must be adapted to the parts to be handled.

The optimization of the operating time of the mobile crane needs a good preparation and a good coordination between the various erection and assembling sequences, the fitter teams, the access possibilities, and the assembling area.

This document aims to familiarize yourself with the whole erection operations of which each one is detailed in the specific files.

4.2.1 Erection instructions

- These instructions concern:
 - The erection of the crane
 - The increase in height of the crane
 - The dismantling of the crane
- All the handling operations must be carried out according to the instructions of this manual, and especially:
 - Ensure the correct supports of the loads
 - Do not work with overload
 - Use hoists in perfect condition and dimensioned for the weight of the elements to be handled.
 - Observe the hoisting points

The erection operations can only be carried out with the wind speed below 14 m/s.

The erection operations must be carried out in the order indicated in this manual.

During the preparing steps compulsorily fit the safety equipment such as ladders, platforms, grab rails, guard ropes, etc. in order to use them during the erection.



Any hoisting operation is absolutely forbidden if the counter ballast is not placed.

- For cranes on chassis and cross-shaped base, the ballast placed must correspond to the hook height to be reached. In case of partial ballasting, the partial ballast must correspond to the erection height of the crane, but must never be lower than the indicated minimum value.
- For cranes with special operating conditions, observe the given instructions.

- For any particularly problem concerning the assembly organization or any other matter, do not hesitate to ask for the technical assistance of the constructor.



For each crane, there are variable elements according to the models, versions, options. The sketches used on the following pages represent the crane in one of its possible configurations. When these sketches explain only a function, they have a grey outline.



Before assembling the sections, carry out a visual check of the steel structure parts, welds and assembling parts. Elements which show deformations, corrosion and cracked welds must be returned to the workshop for repairing.

4.2.2 Fitting the split pins

In order to ensure their pin locking function correctly, this split pin type must be fitted by opening both split pin legs and not only the longest one (Detail B).

It is not compulsory to fold down the legs against the pin; It is sufficient to fold down each leg according to an angle α , depending on the split pin diameter (detail C and table below). This limited opening makes the split pin removal easier when dismantling the crane pins.

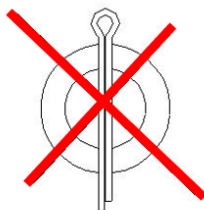
Nevertheless, it is necessary to check that the legs are not running the risk of abutting against obstacles, what may lead to their deformation, and even their deterioration in case of shaft rotation.

In order to avoid this disadvantage, it may be necessary to fold the legs completely (Detail D).

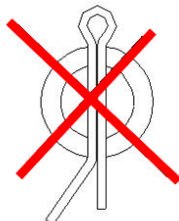


Only use new split pins or split pins in good working order.

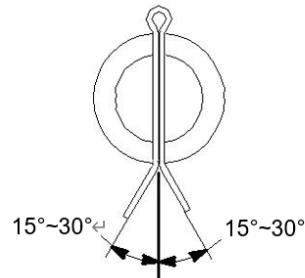
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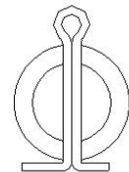
B



C



D



4.2.3 Fitting the high-strength bolt



The preload of the high-strength bolt must be aligned with the data in the following Table 4-1

Table 4-1 Preload of high-strength bolt

Performance grade	Strength of extension Rm N/mm ²	Yield point Rel N/mm ²	Preload F ₁ kN									
			M16	M18	M20	M22	M24	M27	M30	M33	M36	M39
8.8	≥800	≥640	70	86	110	135	158	205	250	310	366	437
10.9	≥1000	≥900	99	120	155	190	223	290	354	437	515	615
12.9	≥1200	≥1080	119	145	185	229	267	347	424	525	618	738
Calculate the effective area of the bolt			157	192	245	303	353	459	561	494	817	976
Note: The preload value in the table is calculated as 0.7 Rel, in which Rel take the minimum value in each gear.												

4.3 Erecting processes overview

Erect the tower crane according to the erecting processes:

■ Outrigger stationary tower crane

- 1) Install the base tower section to the outrigger and embed them to the foundation;
- 2) Install two tower sections to the base tower section;
- 3) Fix the climbing unit (mainly consists of climbing equipment, climbing mechanism, climbing hydraulic cylinder, pump station) to the tower sections;
- 4) Install the transition beam and mounting device to the top tower section;
- 5) Install the slewing unit (mainly consists of turntable, slewing ring, Slewing support, slewing mechanisms, cabin, resistor cabinet, electric control cabinet) to the transition beam;
- 6) Install jib I (with trolley) and jib II (with trolley mechanism) to the turntable;
- 7) Install the counter jib (no middle counter-jib when jib at 45m~60m, no front counter-jib when jib at 30m~40m) to jib I ;
- 8) Install the hoisting mechanism and derrick to the rear counter-jib;
- 9) Install a counter ballast of **12.5t** to the first (jib side) counter ballast slot of rear counter-jib;
- 10) Install the rest jib sections;
- 11) Install the rest counter ballasts;
- 12) Wind the hoisting rope and install the hook;
- 13) Connect the power cables of mechanisms;
- 14) Install the electric control system;
- 15) Install the attachment parts such as warning light, anemometer, camera.

■ Stationary chassis tower crane

- 1) Assemble the chassis;
- 2) Place the central ballasts;
- 3) Install three tower sections to the chassis;
- 4) The other processes are the same with 3)~15) of **Outrigger stationary tower crane**.

■ Travelling chassis tower crane

- 1) Install the travelling bogies;
- 2) The other processes are the same with 1)~4) of **Stationary chassis tower crane**.

4.4 Auxiliary lifting equipment

4.4.1 General notes

The minimum characteristics of the auxiliary lifting equipment are determined by:

- The hoisting height of the jib
- The weight of the jib
- A minimum radius of 10 m from the slewing axis of the auxiliary of the auxiliary lifting equipment.

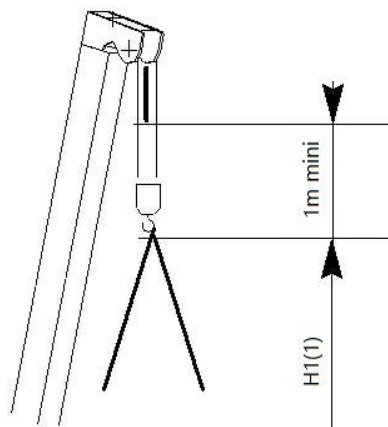
4.4.2 Hook height

The hook height of height of the auxiliary lifting equipment (H1) is equal to the hook height (H2) of the crane to be erected plus X m depending on the packages.

The H2 height is given with respect to the ground support level of the crane.



If the auxiliary lifting equipment does not work at the same level as the erection area of the crane, or due to special site conditions, adjust the height and the radius to determine correctly the characteristics of the auxiliary lifting equipment.



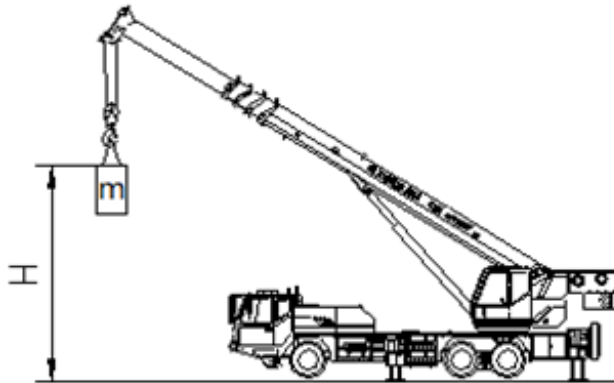
H1 must not be obtained in the upper limit switch position of the auxiliary lifting equipment.

4.4.2.1 Erection by means of a mobile crane

Erect the tower crane to reach the base state by means of the mobile crane, then add tower sections by climbing processes to reach the needed working height. The reference lifting heights and weights are shown in table below.



The information below is for reference only, you can adjust the lifting way according to the actual situation.



No.	Lifting parts		Weight (t)	Lifting height H (m)		
				Outrigger stationary	Stationary chassis	Travelling chassis
1	Travelling bogies		9.2×4	-	-	3
2	Piece beam		11.1×2	-	3	5
3	Straight strut		0.3×2	-	3	5
4	Incline strut		0.4	-	3	5
5	Strut		2.4×4	-	14.4	16.4
6	Base tower section of chassis		8.3+10.9	-	14.4	16.4
7	Central ballast		12.5×8*	-	16.4	18.4
8	Base tower section X42Rb		8.5	6.5	-	-
9	Tower section X42D		8.5×2 / ×3	18.2	31.2	33.2
10	Climbing unit		32.5	31.7	44.7	46.7
11	Transition beam + Mounting device		15.3	21.0	34.0	36.0
12	Slewing unit		21.2	25.3	38.3	40.3
13	Jib I with trolley		15.3	28.5	41.5	43.5
14	Jib II with trolley mechanism		12.3	26.0	39.0	41.0
15	Counter jib	65m~80m	21.8	26.0	39.0	41.0
		45m~60m	17.7			
		30m~40m	14.3			

No.	Lifting parts		Weight (t)	Lifting height H (m)		
				Outrigger stationary	Stationary chassis	Travelling chassis
16	Hoisting mechanism (without hoisting rope)		12.5	31.0	44.0	46.0
17	Derrick		1.2	31.0	44.0	46.0
18	A counter ballast of 12.5 t		12.5	32.8	45.8	47.8
19	The rest jib	80m	25.2	26.0	39.0	41.0
		75m	24.4			
		70m	23.2			
		65m	22.5			
		60m	18.4			
		55m	19.9			
		50m	15.8			
		45m	16.4			
		40m	12.3			
		35m	11.8			
		30m	7.7			
20	The rest counter ballasts	80m	4×12.5+6.5	32.8	45.8	47.8
		75m	4×12.5+6.5			
		70m	3×12.5+10+6.5			
		65m	4×12.5			
		60m	5×12.5			
		55m	5×12.5			
		50m	3×12.5+10+6.5			
		45m	3×12.5+10+6.5			
		40m	5×12.5+6.5			
		35m	4×12.5+10+6.5			
		30m	4×12.5+10			

4.5 Installing the mast sections

4.5.1 Installing the base tower section

As shown in figure below, sling the assembled base section on the outrigger, **pay attention to the direction of lug and platform ladder must accordance with the installed base section.** Use 8 $\Phi 75$ pins connected to outrigger, and then knock the pin until the pin hole is aligned with the base section, insert the small pins and spring pins. **Notice: Ensure all holes and pins should be clean, free of any dirt.**

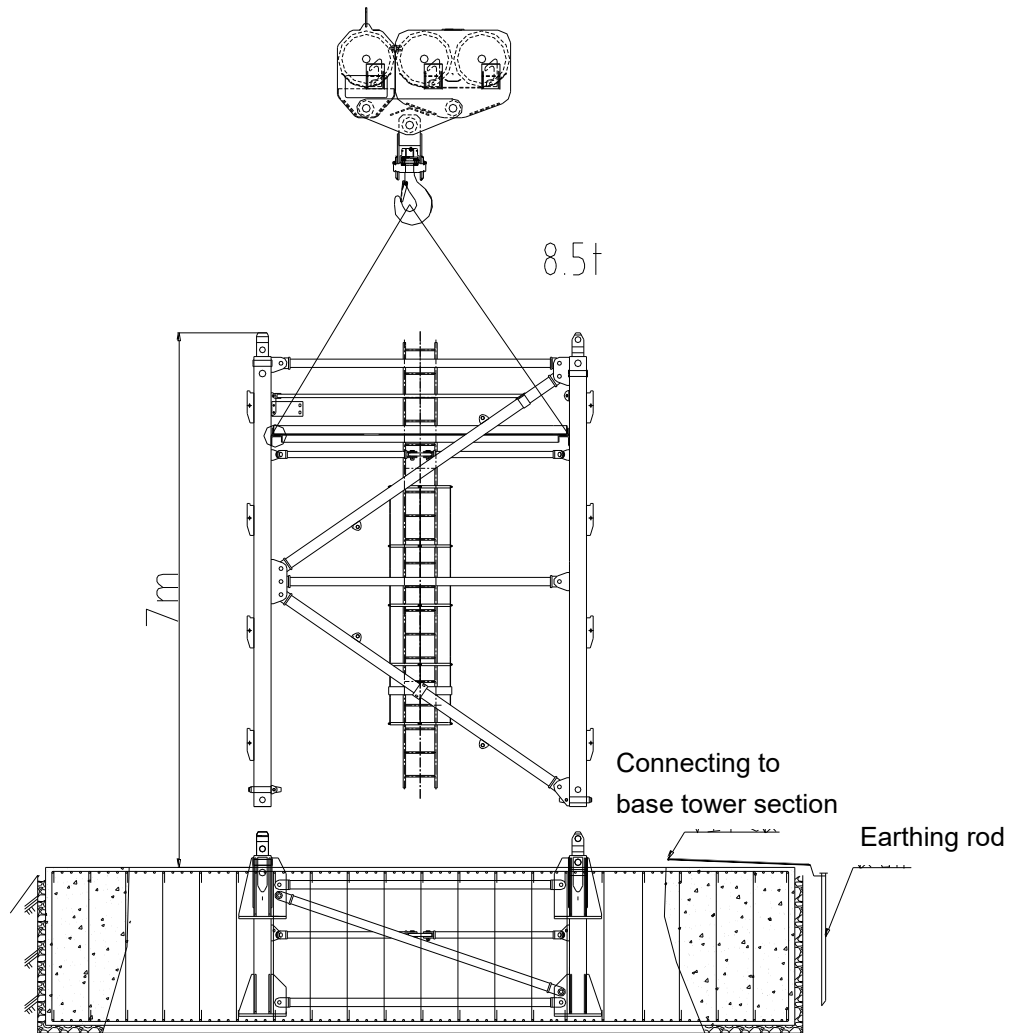


Fig. 4-1 Installing the base tower section

Table 4-2 Parts of installing base tower section

No.	Designation	Specification	Qty
1	Base tower section		1
2	Pin	XZ-75-290/420	8
3	Lock pin	XZ03A-25×175/205	8
4	Spring pin	d1=6.3	16

4.5.2 Installing two tower sections

As shown in figure below, sling the assembled tower section on the base section;

Table 4-3 Parts of installing two tower sections

No.	Designation	Specification	Qty
1	Base tower section		1
2	Pin	XZ-75-290/420	8
3	Lock pin	XZ03A-25×175/205	8
4	Spring pin	d1=6.3	16

The connection of tower section through 8 $\Phi 75$ pins, and then knock the pin until the pin hole is aligned with the tower section, and then insert the pivot pins.

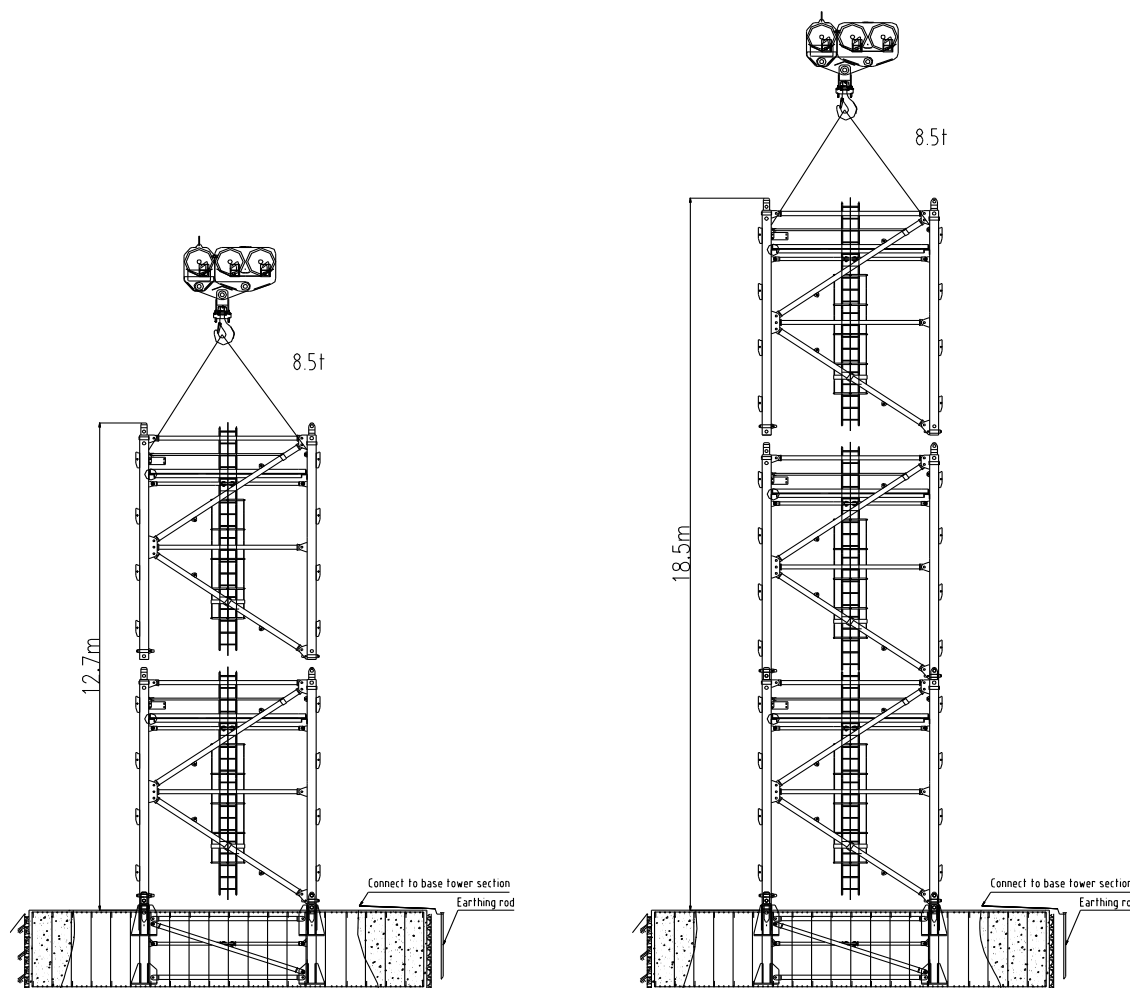
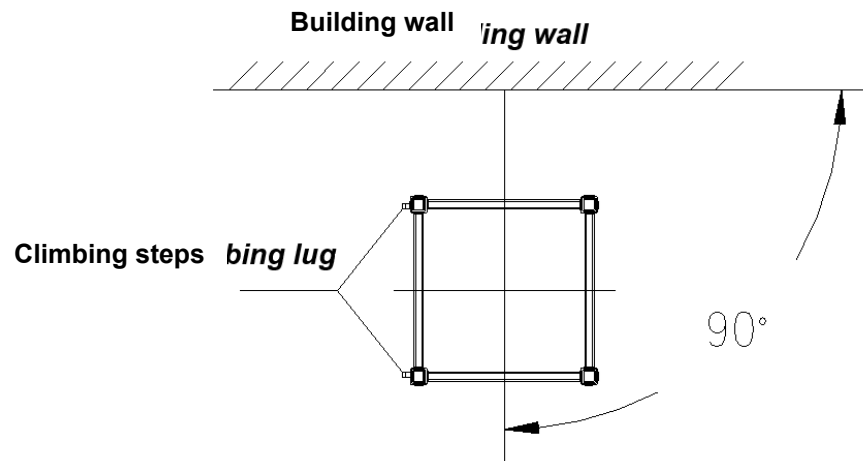


Fig. 4-2 Installing two tower sections



When installing, pay attention to the direction of tower sections' climbing steps; Recommended installing the bolt from top to bottom, also install from bottom to top according actual condition, meet the stress condition.



In order to ascend and descend the tower crane successfully, please ensure that the plane with climbing steps is perpendicular to the building.

4.6 Installing the climbing unit

4.6.1 Assembling the climbing unit

The climbing unit consists of the climbing equipment, platforms, ladders and hydraulic system, etc. Climbing hydraulic cylinder is installed on the beam of the front and rear of climbing frame (that is two sides of tower section lug). Hydraulic pump station is installed on the left and right platform. There are 16 rollers which are close to main chord of mast, acts guide when climbing.

- 1) As the following figure shows, assemble the chord A and B which near to the connecting flange and having the welding identifier "1" together to be the main chord A, the parts are shown in the table below.

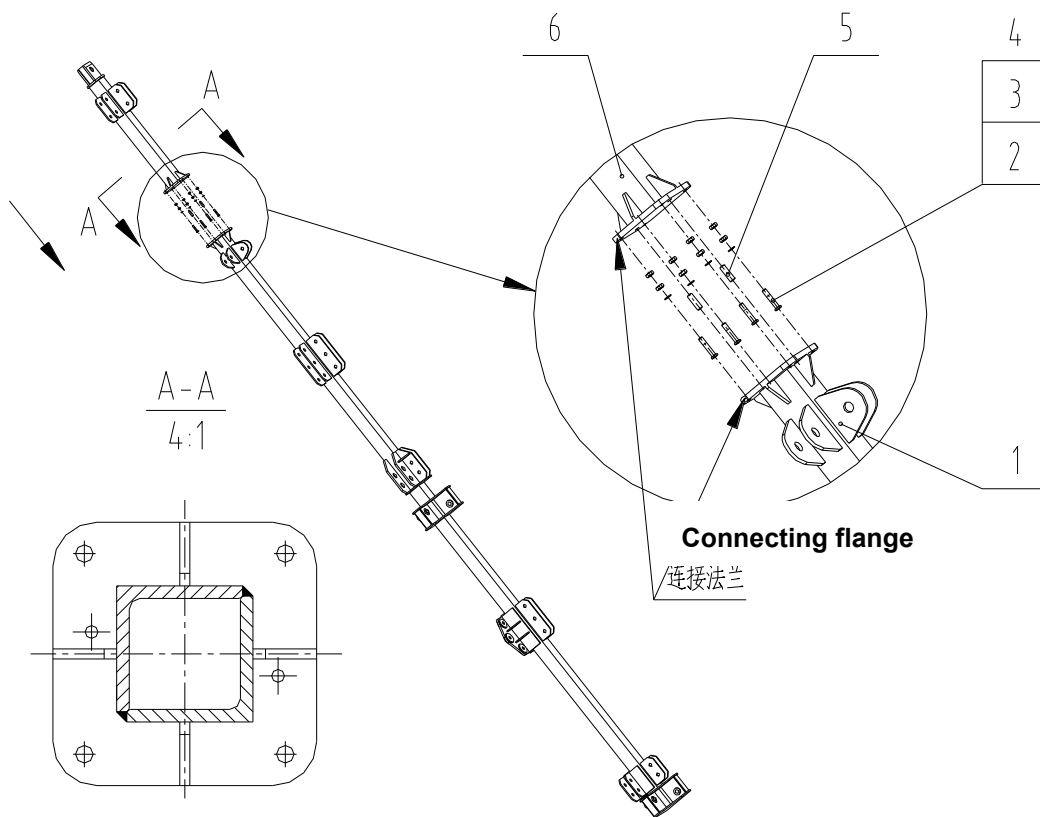


Fig. 4-3 Assembling the chord A and B

Table 4-4 Parts of assembling the chord A and B

No.	Designation	Specification	Qty
1	Chord A		1
2	Bolt M24×120	GB/T5782-2000	4
3	Washer 24	GB/T97.1-2002	4
4	Nut M24	GB/T6170-2000	8
5	Locating pin		2
6	Chord B		1

- 2) Repeat the step 1), assemble the rest main chord B (welding identifier is "2"), main chord C (welding identifier is "3"), and main chord D (welding identifier is "4").
- 3) Assemble the main chords A and C with the web members to be the rear piece, refer to the figure and parts table below.

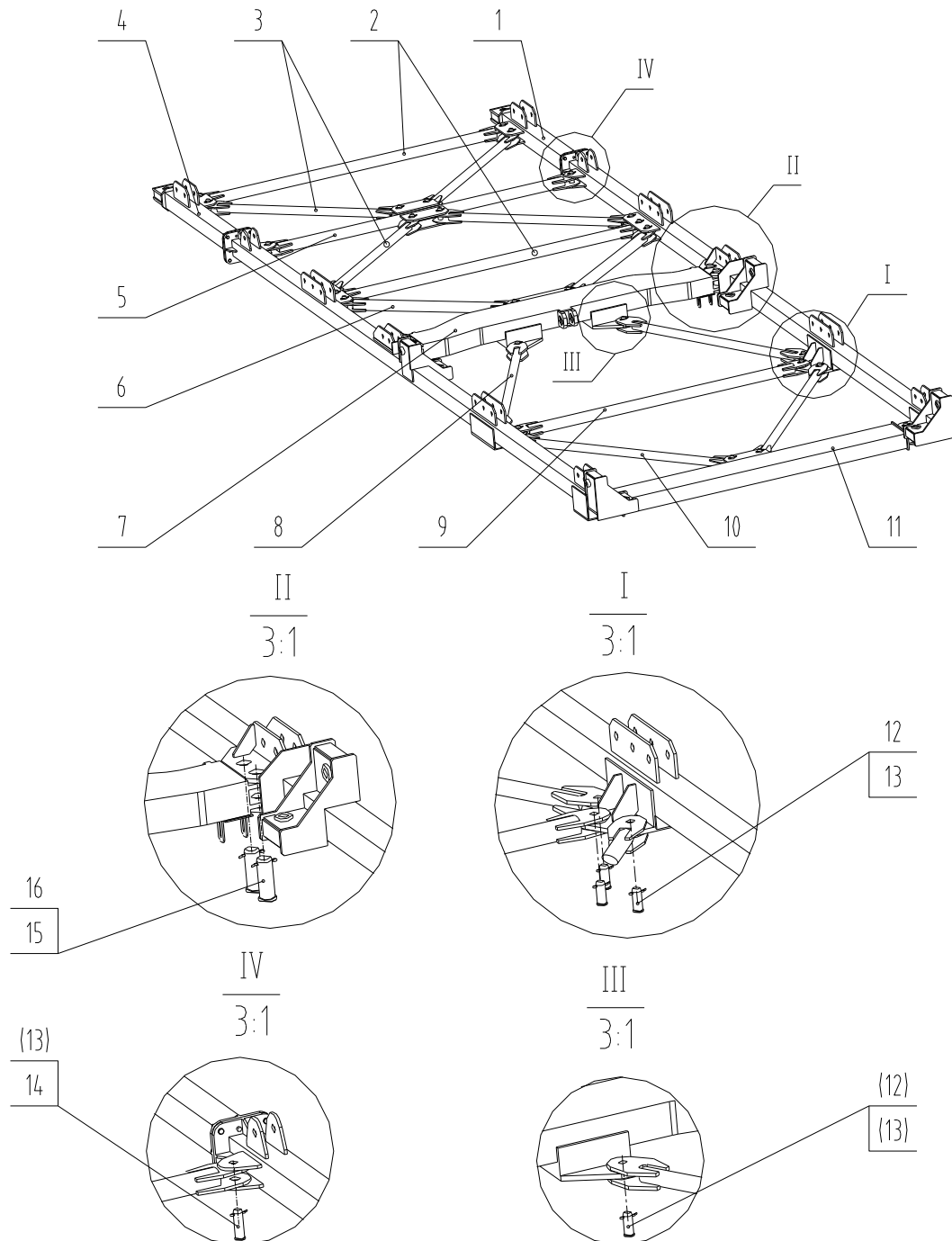


Fig. 4-4 Assembling the rear piece

Table 4-5 Parts of assembling the rear piece

No.	Designation	Specification	Qty
1	Main chord A		1
2	Cross beam B		2
3	Diagonal web member A		4
4	Main chord C		1
5	Cross beam A		1
6	Diagonal web member B		2
7	Cross beam D		1
8	Diagonal web member C		2
9	Cross beam G		1
10	Diagonal web member D		2
11	Cross beam E		1
12	Pin D	$\Phi 60 \times 120/150$	8
13	Split pin 10 $\times$ 80	GB/T91-2000	32
14	Pin B	$\Phi 60 \times 164/194$	24
15	Pin A	$\Phi 100 \times 239/272$	4
16	Split pin 13 $\times$ 125	GB/T91-2000	4

- 4) Assemble the rear piece and diagonal web members to be a U-piece, refer to the figure and parts table below.

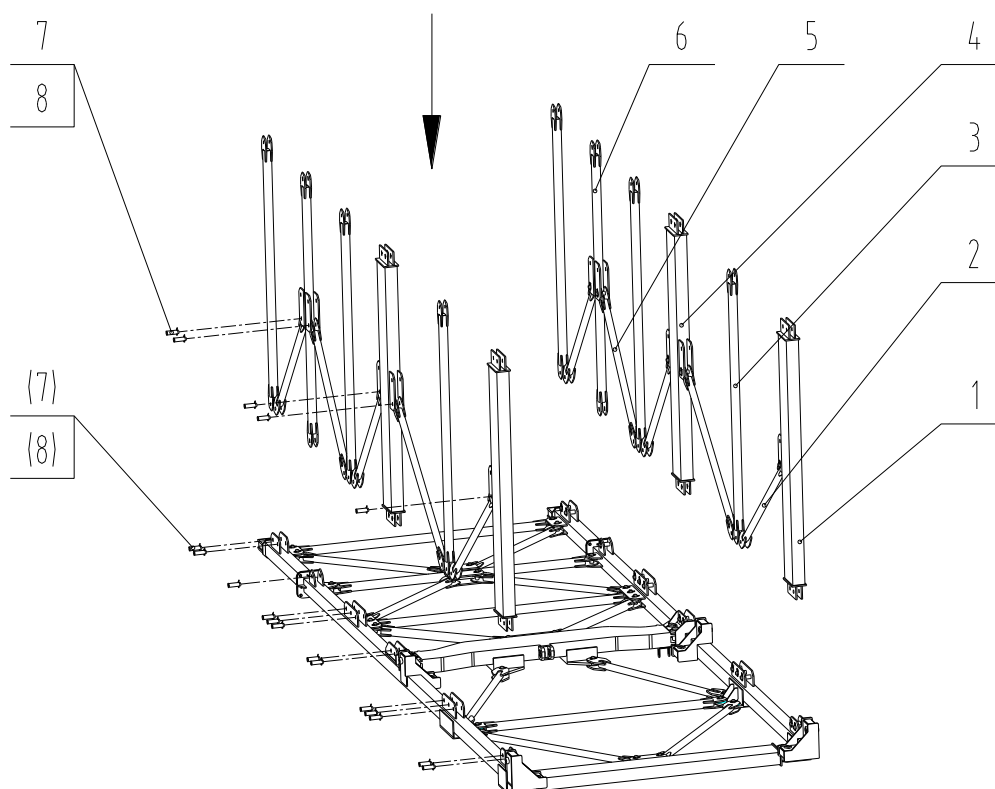


Fig. 4-5 Assembling the U-piece

Table 4-6 Parts of assembling the U-piece

No.	Designation	Specification	Qty
1	Cross beam E		2
2	Diagonal web member D		4
3	Cross beam B		6
4	Cross beam C		2
5	Diagonal web member A		6
6	Cross beam A		2
7	Pin B	$\Phi 60 \times 164/194$	36
8	Split pin 10×80	GB/T91-2000	36

- 5) Assemble the main chord B and D with the web members to be the front piece, refer to the figure and parts table below.

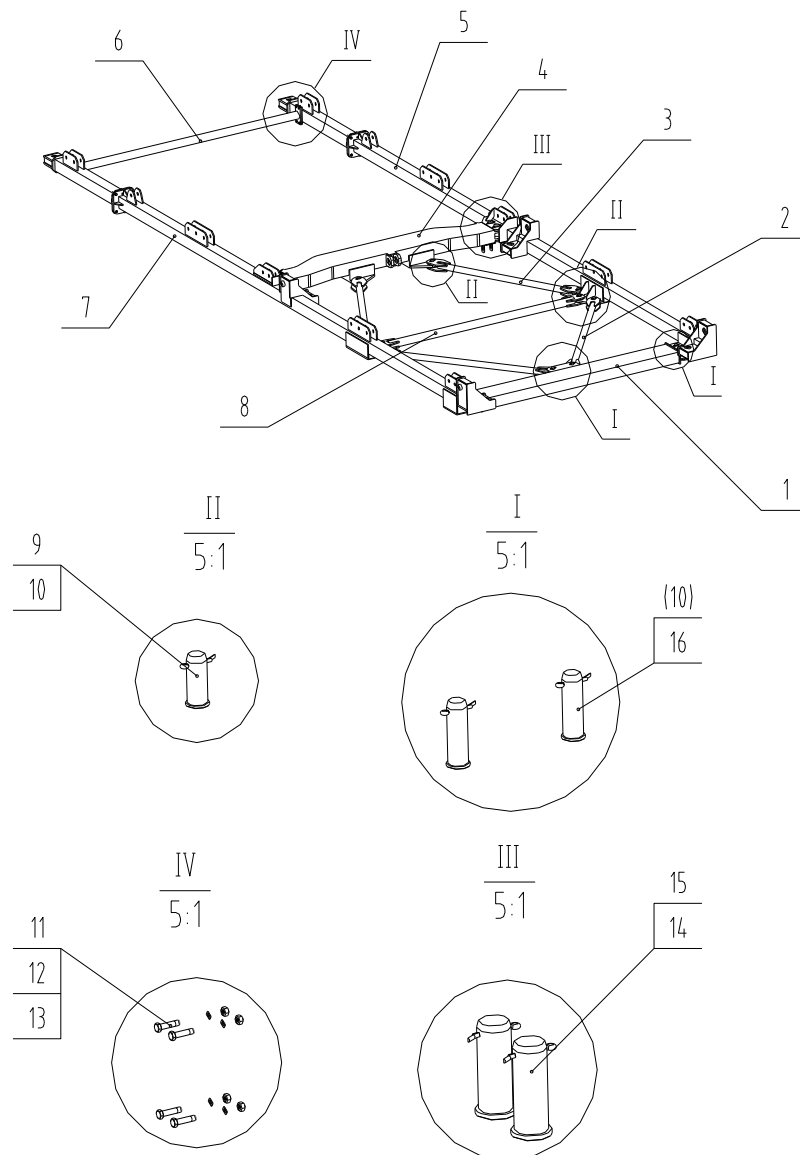


Fig. 4-6 Assembling the front piece

Table 4-7 Parts of assembling the front piece

No.	Designation	Specification	Qty
1	Cross beam E		1
2	Diagonal web member D		2
3	Diagonal web member C		2
4	Cross beam F		1
5	Main chord D		1
6	Assembling brace rod		1
7	Main chord B		1
8	Cross beam G		1
9	Pin D	Φ60×120/150	8
10	Split pin 10×80	GB/T91-2000	32
11	Bolt M16×65	GB/T5783-2000	8
12	Washer 16	GB/T97.1-2002	8
13	Nut M16	GB/T6170-2000	8
14	Pin A	Φ100×239/272	4
15	Split pin 13×125	GB/T91-2000	4
16	Pin B	Φ60×164/194	24

- 6) Assemble the front piece, the U-piece and diagonal web members to be the whole climbing equipment, refer to the figure and parts table below.

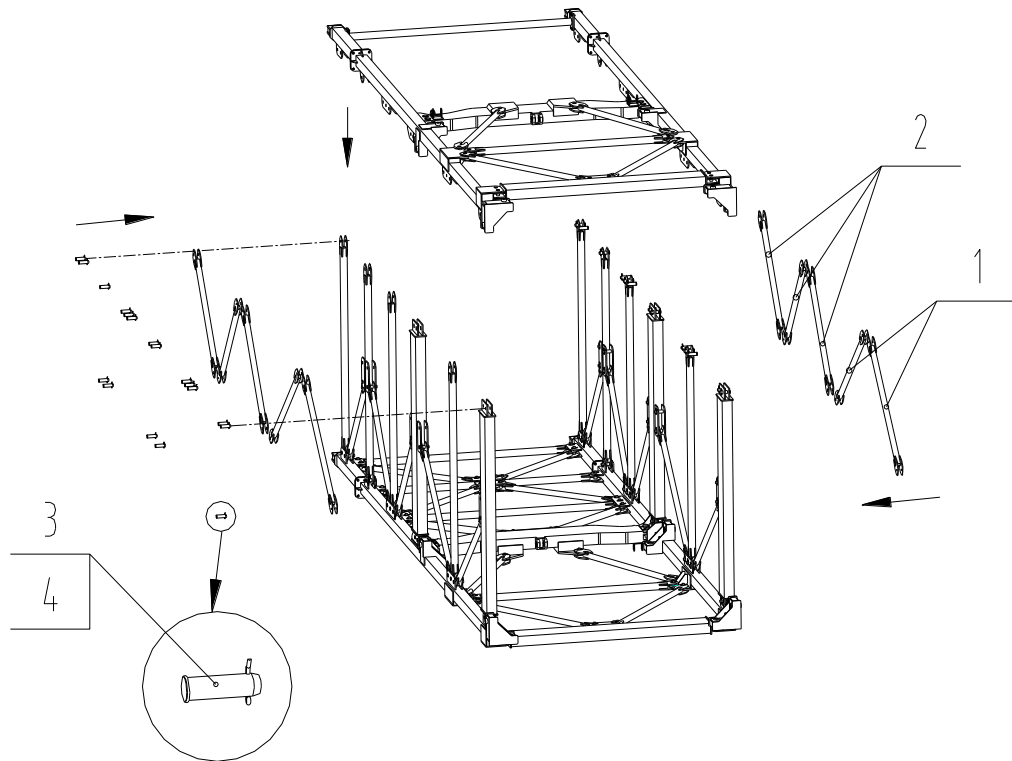
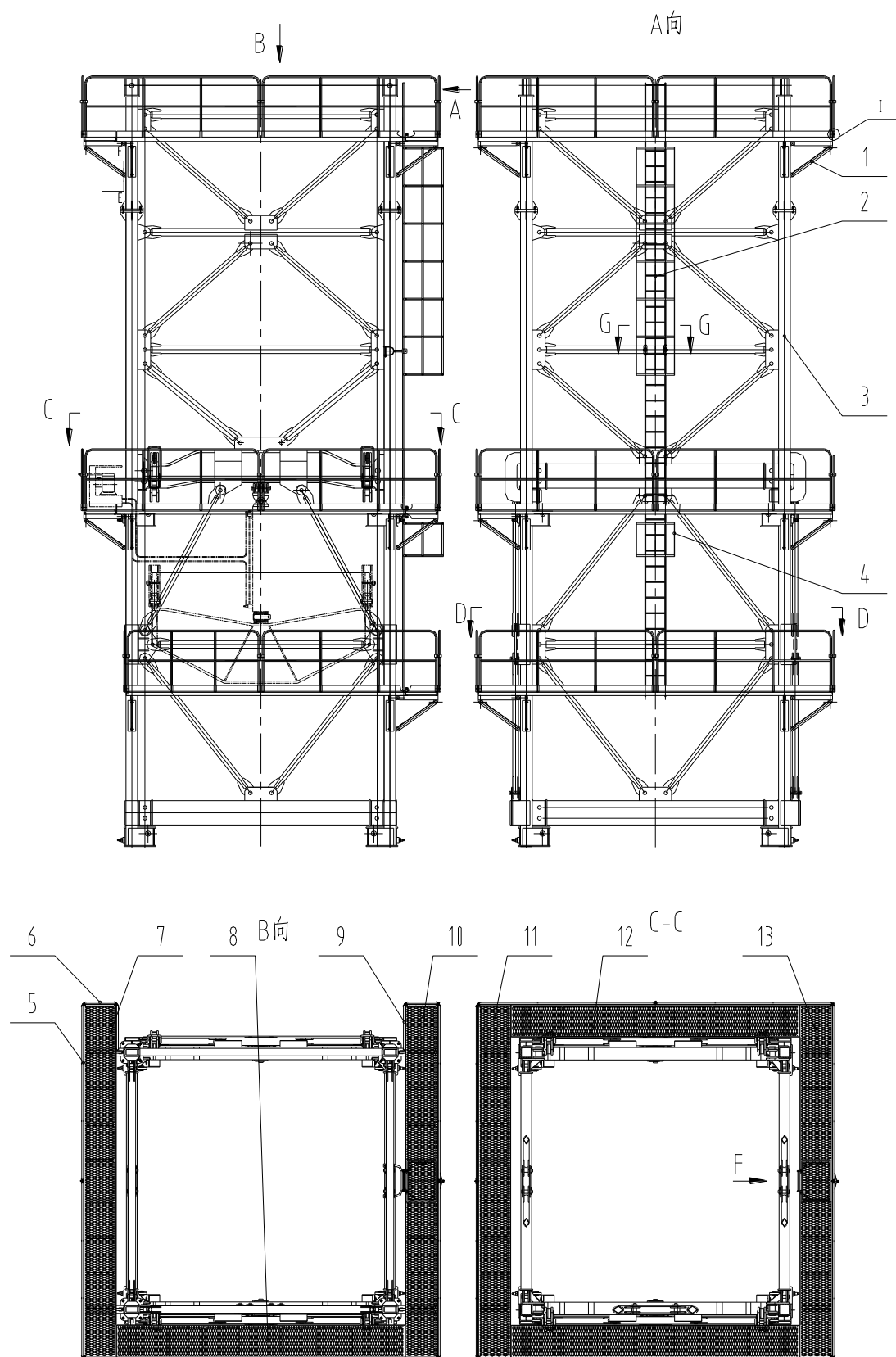


Fig. 4-7 Assembling the whole climbing equipment

Table 4-8 Parts of assembling the whole climbing equipment

No.	Designation	Specification	Qty
1	Diagonal web member D		4
2	Diagonal web member A		6
3	Pin B	$\Phi 60 \times 164/194$	36
4	Split pin 10×80	GB/T91-2000	36

- 7) Assemble the platforms, Railings and passages of three layers, refer to the figure and parts table below.



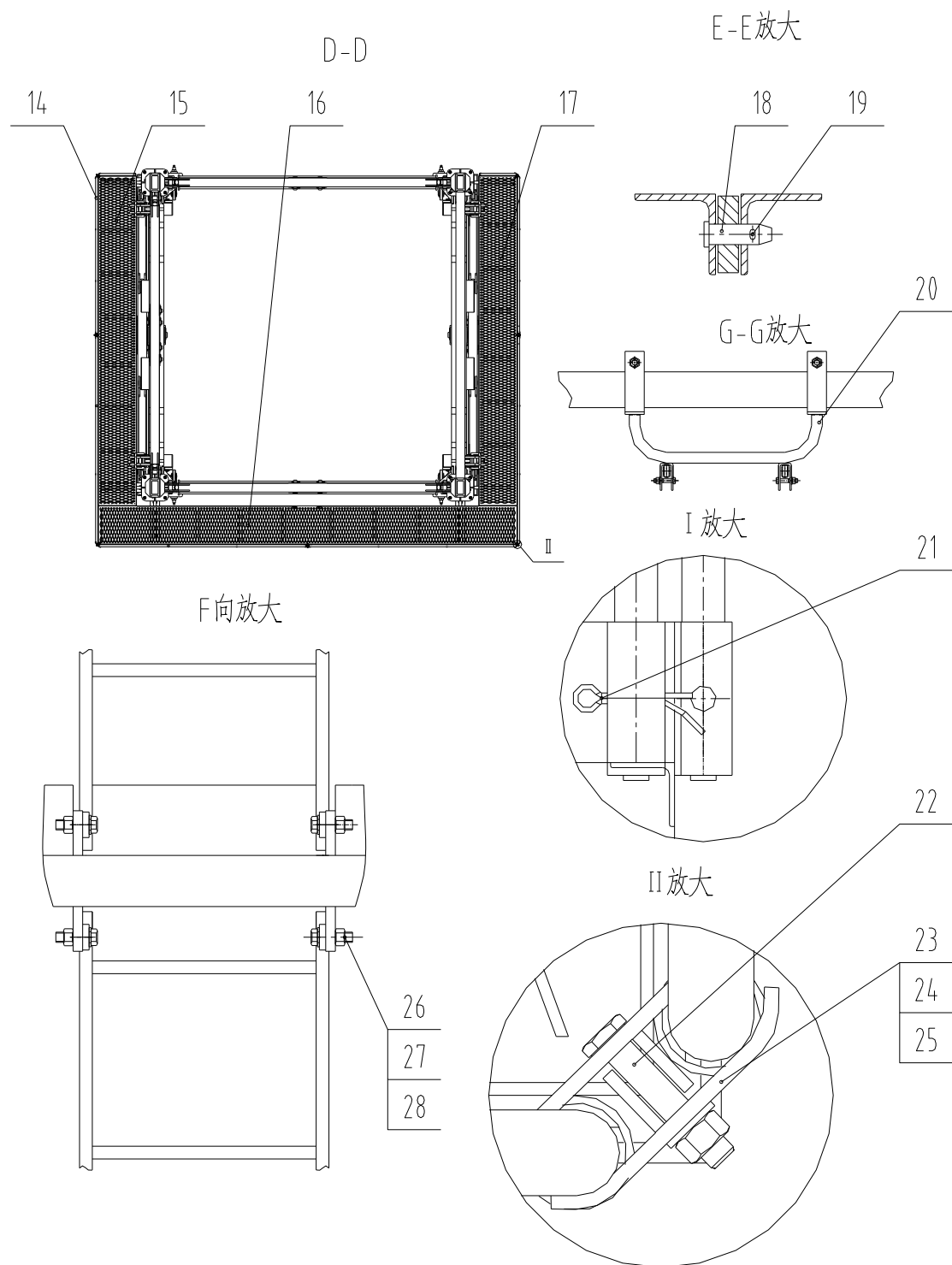


Fig. 4-8 Assembling the platforms, railings and passages

Table 4-9 Parts of assembling the platforms, railings and passages

No.	Designation	Specification	Qty
1	Brace rod		20
2	Ladder A		1
3	Climbing equipment frame		1
4	Ladder B		1
5	Railing A	L=3207	18
6	Railing C	L=540	4
7	Platform I		1
8	Platform II		1
9	Railing B	L=802	2
10	Platform III		1
11	Platform VII		1
12	Platform IX		2
13	Platform VIII		1
14	Railing D	L=2421	2
15	Platform IV		1
16	Platform V		1
17	Platform VI		1
18	Pin		60
19	Split pin 4×32	GB/T91-2000	60
20	Ladder fixing device		1
21	Split pin 8×71	GB/T91-2000	92
22	Bolt M12×65	GB/T5783-2000	24
23	Nut M12	GB/T6170-2000	24
24	Washer 12	GB/T97.1-2002	24
25	Railing clamp plate		48
26	Bolt M16×65	GB/T5783-2000	8
27	Nut M16	GB/T6170-2000	8
28	Washer 16	GB/T97.1-2002	8

- 8) Install 16 sets of idler wheel assembly to the wheel support.
 a) Assemble the idler wheel assembly, refer to the figure and parts table below.

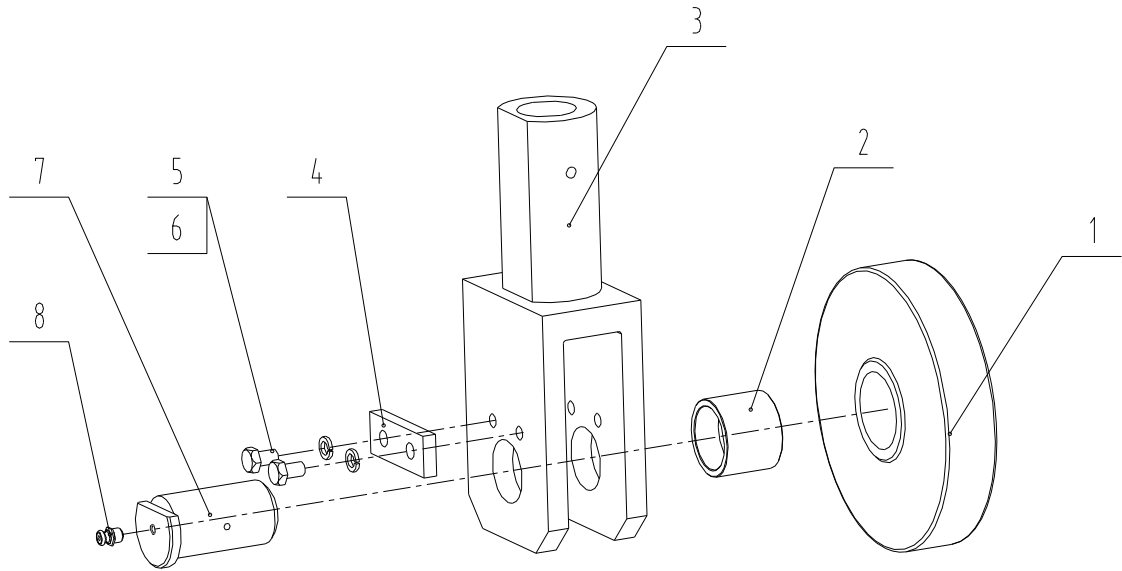


Fig. 4-9 Idler wheel assembly

Table 4-10 Parts of idler wheel assembly

No.	Designation	Specification	Qty
1	Idler wheel		1×16
2	Shaft sleeve		1×16
3	Idler wheel support		1×16
4	Press plate		1×16
5	Bolt M10×16	GB/T5783-2000	2×16
6	Washer 10	GB/T93-1987	2×16
7	Idler wheel shaft	Φ45×82	1×16
8	Oil cup M6	JB/T7940.1-1995	1×16

- b) Install the idler wheel assembly to the wheel support on the climbing equipment structure as the order ①~⑤, refer to the figure and parts table below.

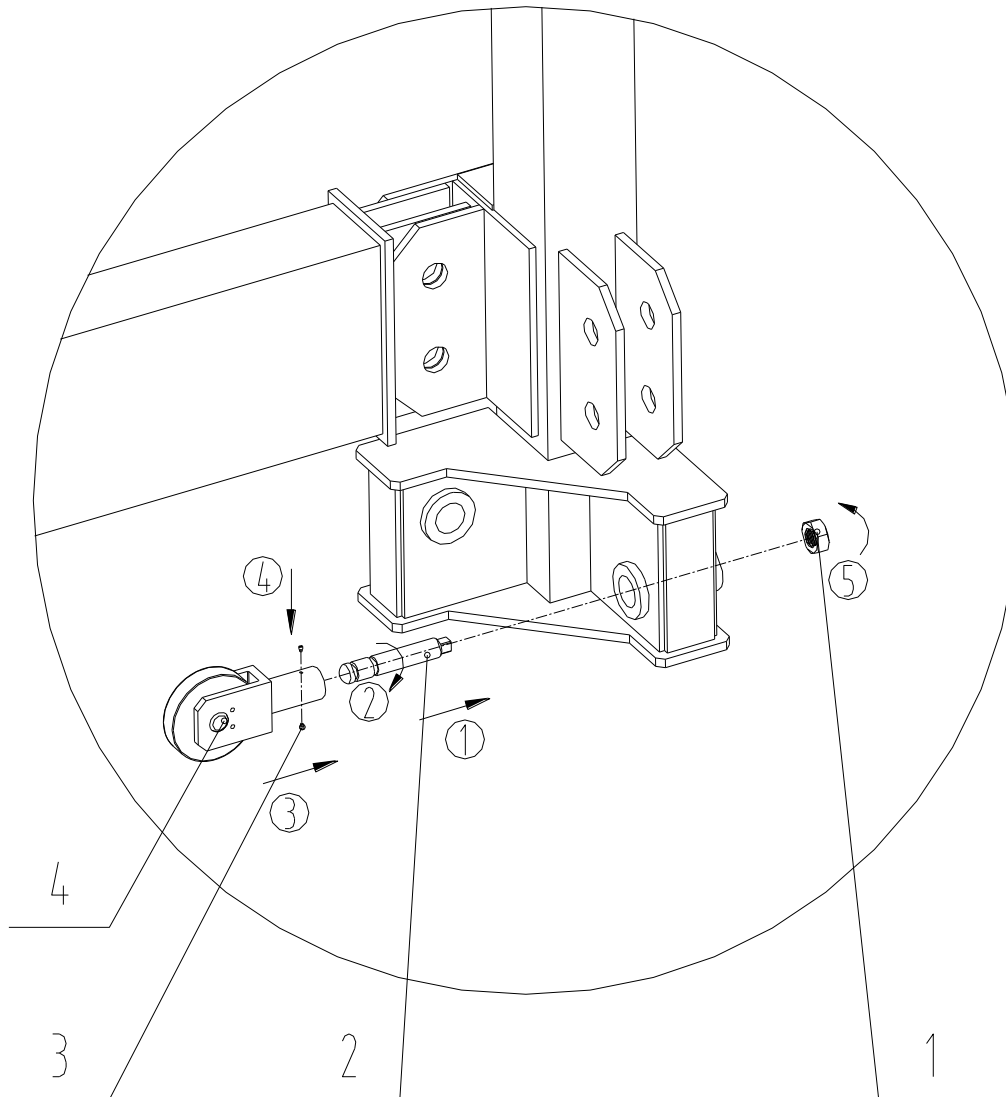


Fig. 4-10 Assembling the idler wheel assemblies to the climbing equipment structure

Table 4-11 Parts for assembling idler wheel assemblies

No.	Designation	Specification	Qty
1	Nut M42	GB/T6170-2000	1×16
2	Screw		1×16
3	Bolt M8×12	GB/T75-1985	2×16
4	Idler wheel assembly		1×16
5	Nut M42	GB/T6170-2000	1×16

- c) Repeat the two steps above to assemble the rest 15 sets of idler wheel assemblies.

- 9) Assemble 4 sets of step-changing support rods to the both sides of the climbing cross beam, refer to the figure and parts table below.

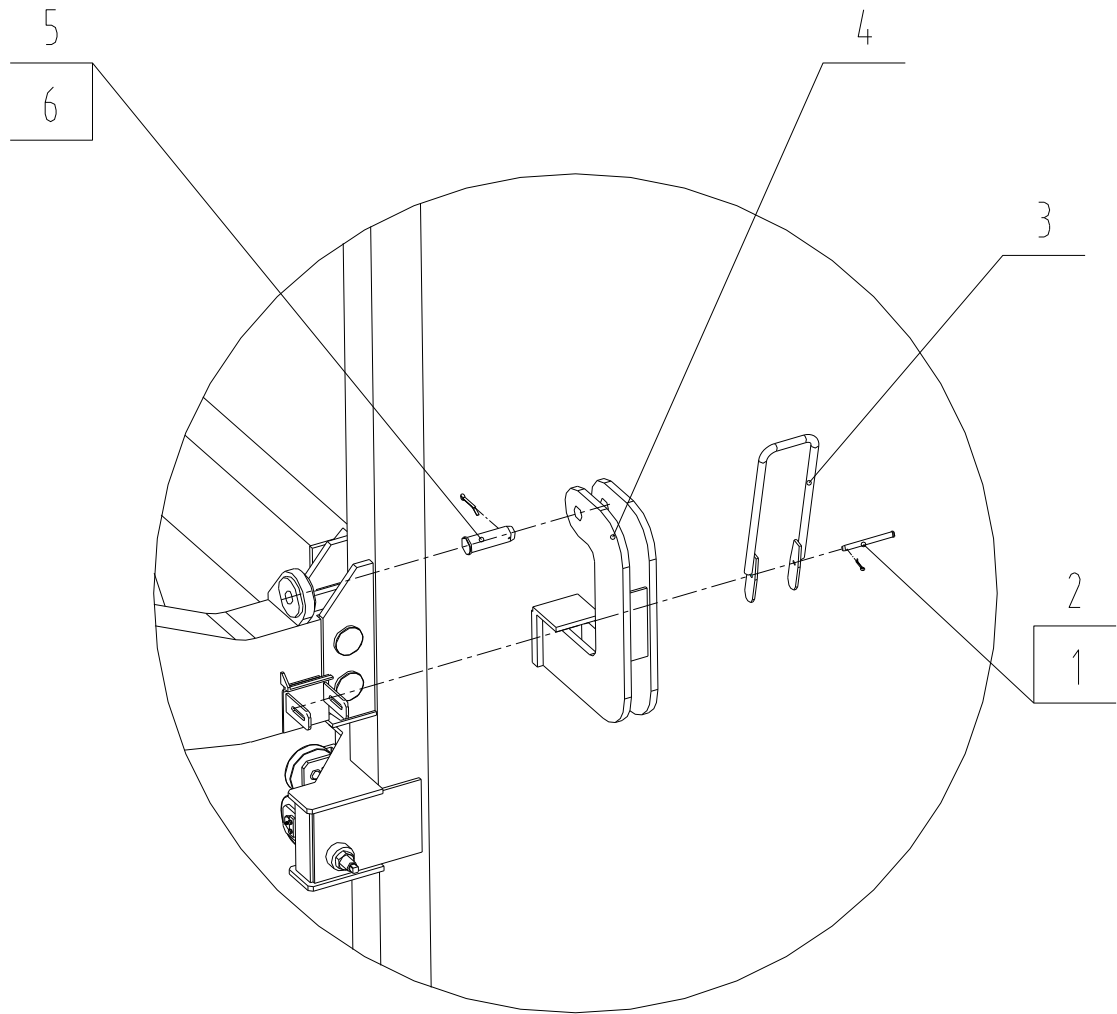


Fig. 4-11 Assembling the step-changing support rods

Table 4-12 Parts for assembling step-changing support rods

No.	Designation	Specification	Qty
1	Pin	$\Phi 20 \times 202/217$	1×4
2	Split pin 5×40	GB/T91-2000	1×4
3	Handle		1×4
4	Step-changing support rod		1×4
5	Pin B	$\Phi 60 \times 164/194$	1×4
6	Split pin 10×80	GB/T91-2000	1×4

- 10) Assemble two groups of oil cylinder lugs to the middle of the climbing cross beam, refer to the figure and parts table below.

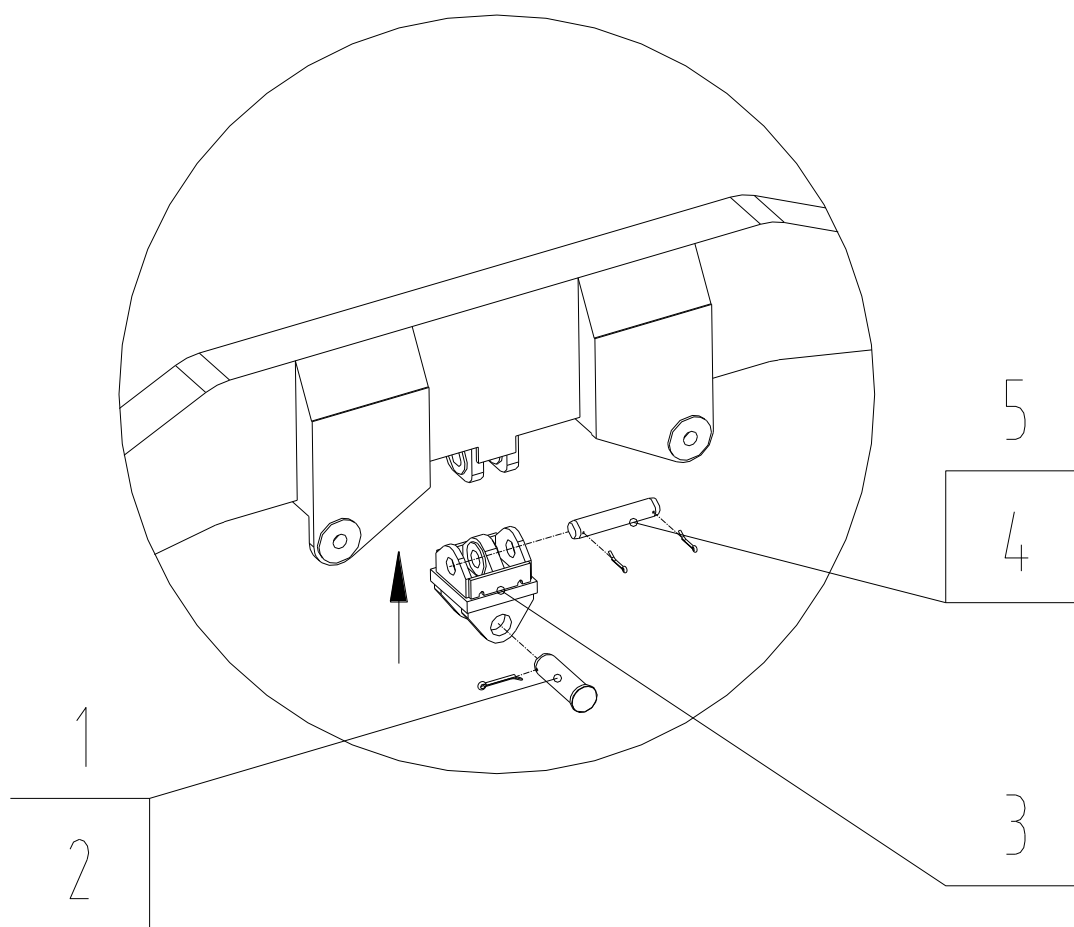


Fig. 4-12 Assembling the of oil cylinder lugs

Table 4-13 Parts for assembling the oil cylinder lugs

No.	Designation	Specification	Qty
1	Pin C	$\Phi 90 \times 266/305$	1×2
2	Split pin 13×125	GB/T91-2000	1×2
3	Oil cylinder lug		1×2
4	Pin	$\Phi 70 \times 300/360$	1×2
5	Split pin 5×40	GB/T91-2000	1×2

11) Assemble the climbing mechanism on the ground, refer to the figure and parts table below.

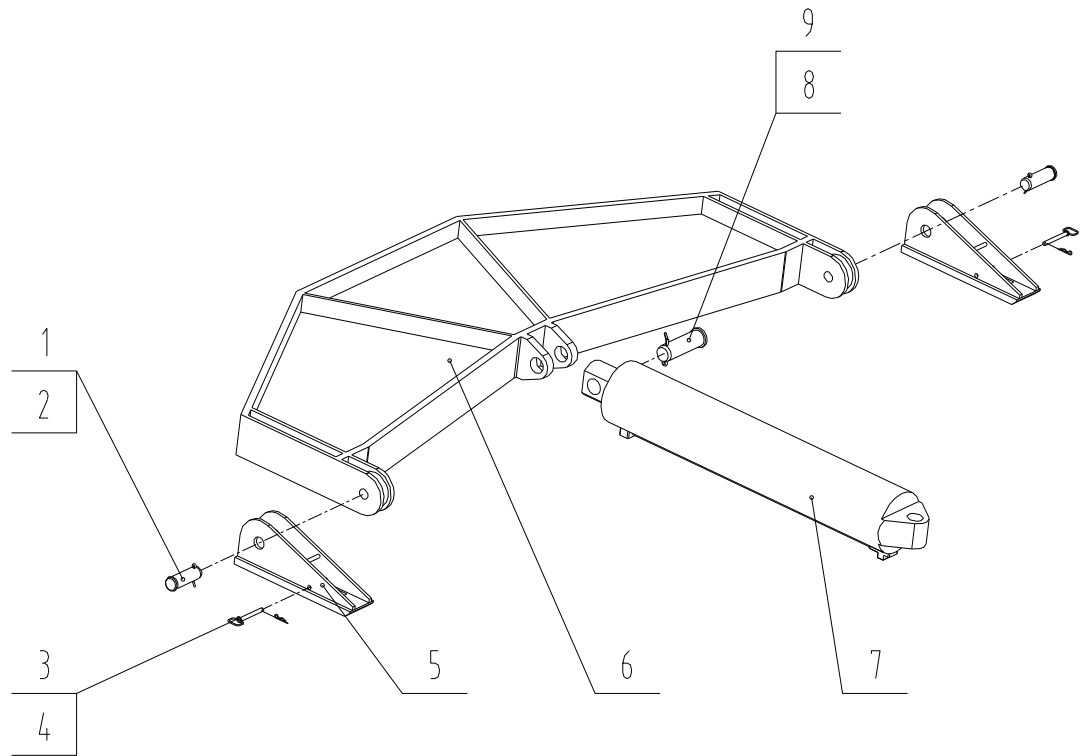
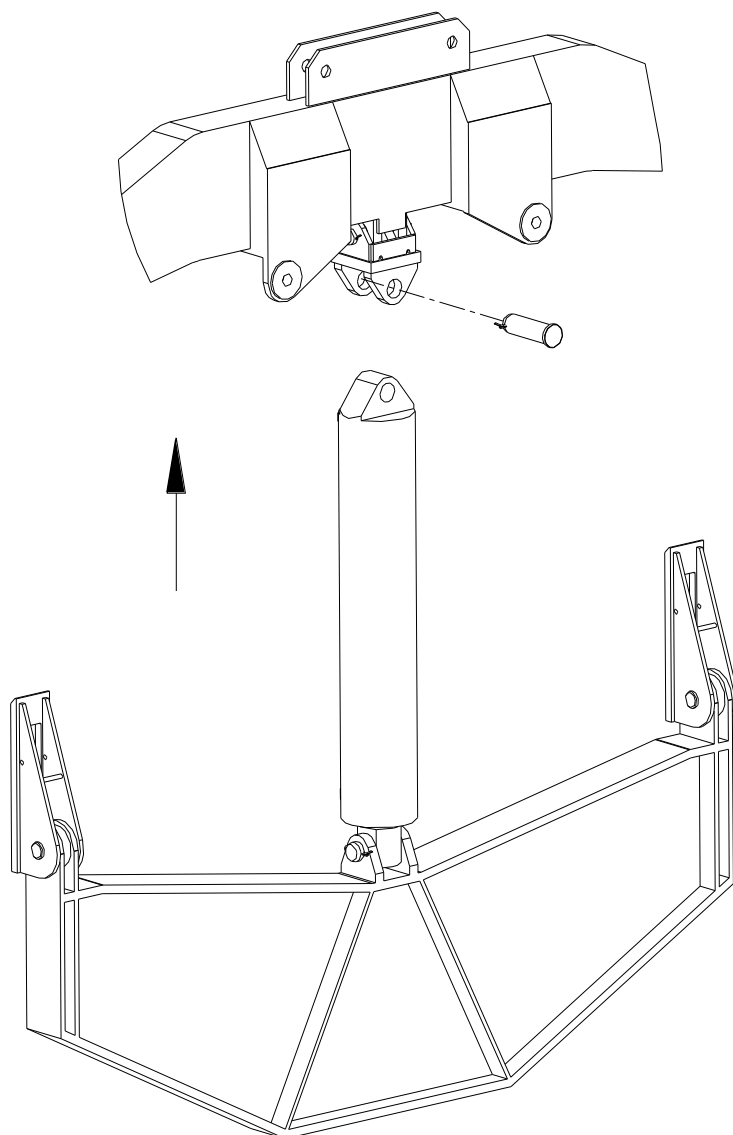


Fig. 4-13 Assembly of the climbing mechanism

Table 4-14 Parts for assembling the climbing mechanism

No.	Designation	Specification	Qty
1	Pin	$\Phi 70 \times 174/204$	2×2
2	Split pin 10×100	GB/T91-2000	2×2
3	Safety pin (with handle)	$\Phi 20$	2×2
4	Spring pin		2×2
5	Hanging plate		1×2
6	Cross beam of hanging plate		1×2
7	Oil cylinder		1×2
8	Pin C	$\Phi 90 \times 266/305$	1×2
9	Split pin 13×125	GB/T91-2000	1×2

- 12) Remove the part 1 and 2 in figure below, install 2 climbing parts to both sides of the oil cylinder lugs.



After installing the climbing mechanism to the climbing equipment structure, tie the hanging plate cross beam to the nearby diagonal web members, so to avoid damaging the oil cylinder when hoisting the whole climbing equipment.

13) Install the pump station to the platform of level 2, refer to the figure and parts table below.

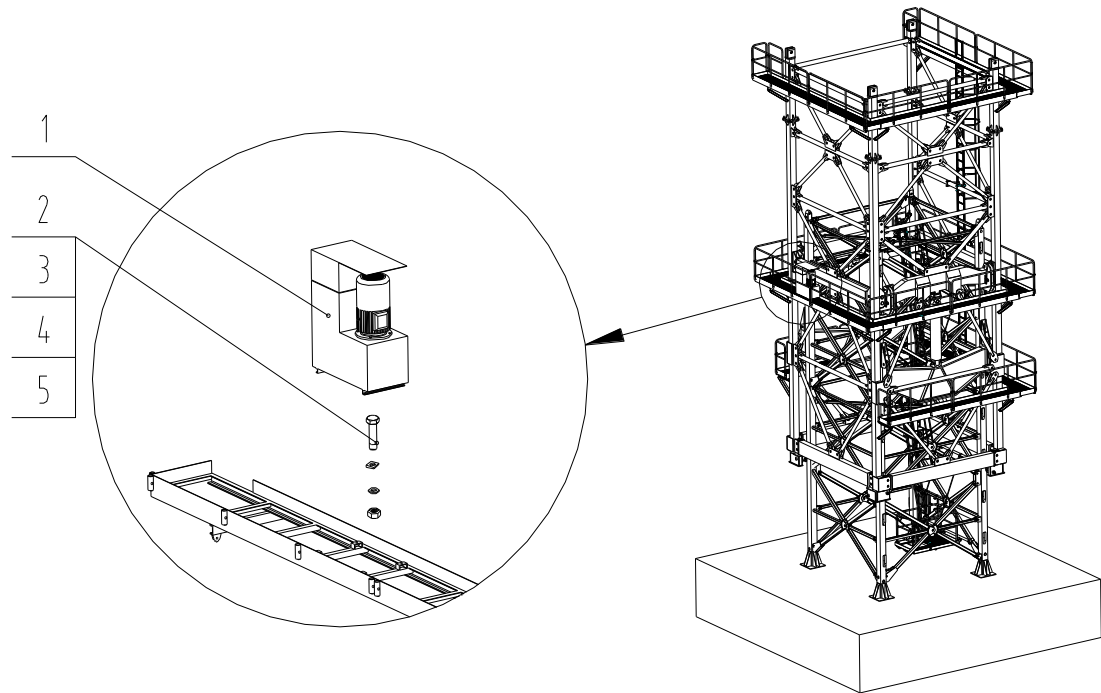


Fig. 4-14 Assembling the pump station

Table 4-15 Parts for assembling the pump station

No.	Designation	Specification	Qty
1	Pump station		1
2	Bolt M12×40	GB/T5783-2000	4
3	Bolt M12	GB/T6170-2000	4
4	Washer 12	GB/T97.1-2002	4
5	Washer 12	GB/T853-1988	4

4.6.2 Installing

- 1) Hoist the climbing equipment assembly and make it cover the mast slowly.
- 2) Set all the 4 step-changing support rods to the seventh steps from bottom to up, then adjust the gaps between the 16 idler wheels and the tower section.
- 3) Remove the rope tying the hanging plate beam and climbing equipment structure. Connect the oil tubes according to the climbing hydraulic system drawing. Check the working condition of the system. Ensure the rotating direction of the vanes of the oil pump motor fans is the same with the arrow on the shell of the motor. If any mistakes happen, check the connect the motor lines again.
- 4) Shrink the oil cylinder, hang the 4 hanging plate on the steps of the tower section nearby the step-changing support rods, then insert the safety pins.
- 5) Remove the part 6 in Fig. 5-16 (assembling brace rods), otherwise tower sections can't be mounted.

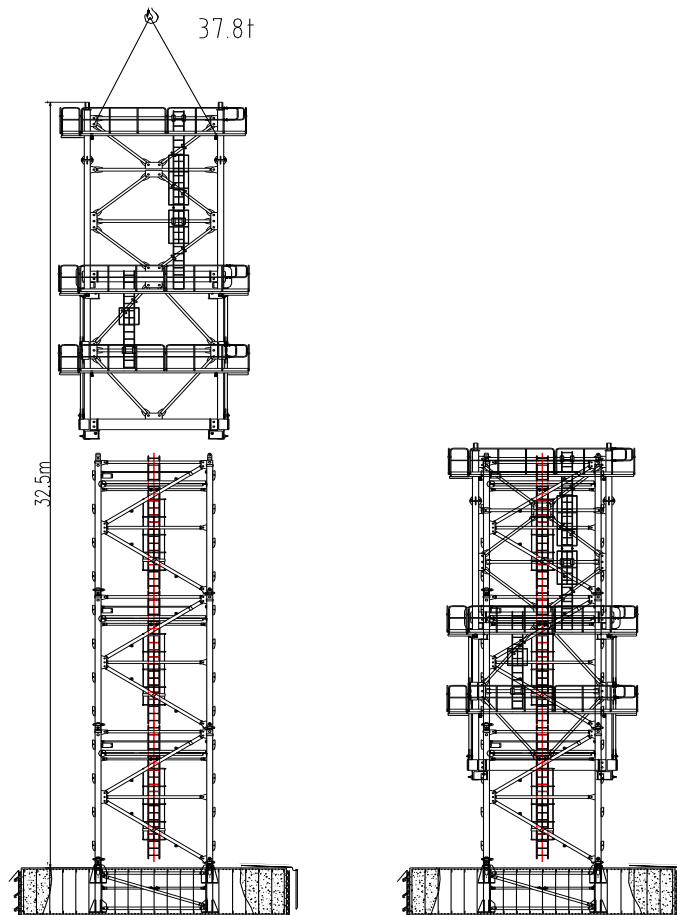


Fig. 4-15 Installing the climbing equipment

4.7 Installing the transition beam and mounting device

4.7.1 Assembling the mounting device

Install the mechanism platform to the mounting beam, and install the railings and splint railings, then connect the railings and mounting beam together, as order ①~③ in Fig. 4-16.

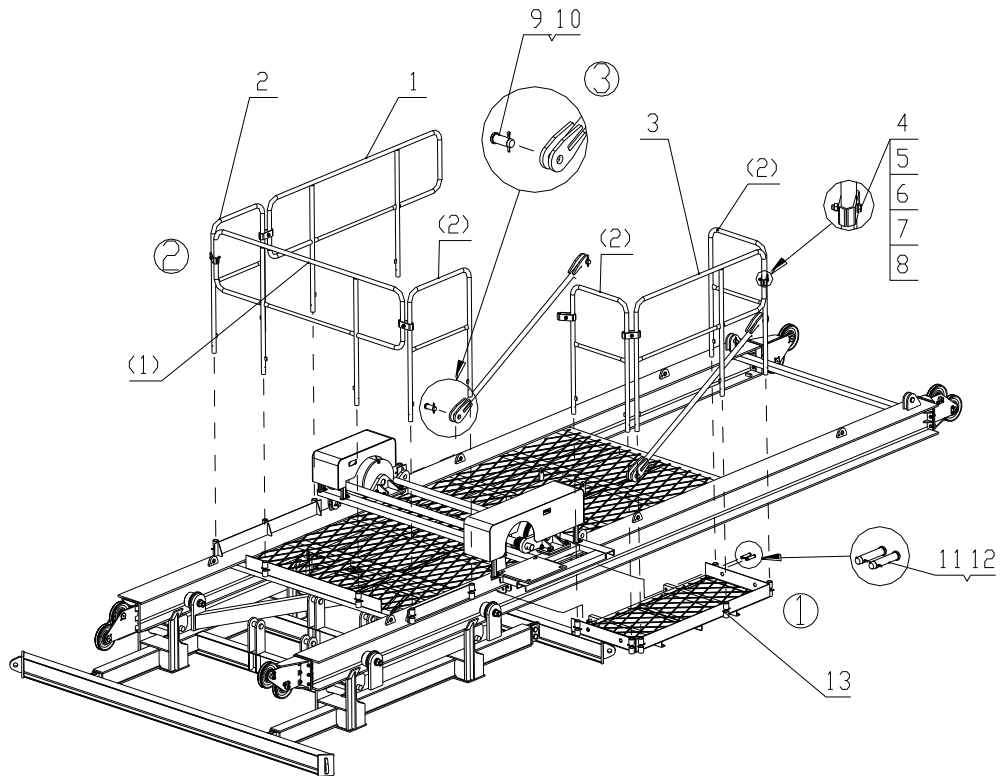


Fig. 4-16 Assembling the mounting device

Table 4-16 Parts for assembling the mounting device

No.	Designation	Specification	Qty
1	Railing	LGB2000B	2
2	Railing	LGA580B	3
3	Railing	LGC1500B	1
4	Bolt	M12×70-8.8	6
5	Nut	M12-8	6
6	Washer	12	12
7	Washer	12-200HV	12
8	Railing splint	t6	12
9	Pin	35×70	4
10	Split pin	8×71	4
11	Pin	20×80	4
12	Split pin	5×32	4
13	Mechanism platform		1

4.7.2 Assembling the transition beam

The transition beam is a cross beam, it mainly consists of a whole beam and 2 half beams, assemble them by 28 sets of M30×110 bolt (level 10.9), as shown in Fig. 4-17.

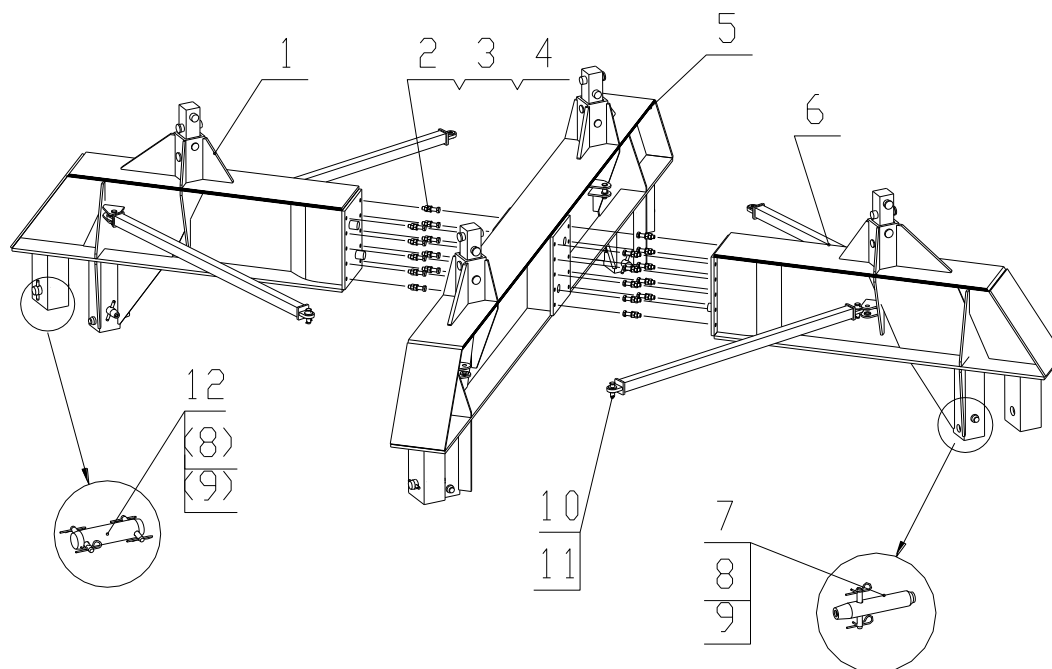


Fig. 4-17 Assembling the transition beam

Table 4-17 Parts for assembling the transition beam

No.	Designation	Specification	Qty
1	Half beam I		1
2	Bolt	M33×150-10.9	28
3	Nut	M33-10	56
4	Flat washer	33-300HV	56
5	Whole beam		1
6	Half beam II		1
7	Pin	Φ75×290	8
8	Pin	XZ03A-25×175/205	16
9	Split pin	d1=6.3	32
10	Pin		

4.7.3 Connecting the mounting device and transition beam

Hoist the transition beam onto the mounting device, connect them by 4 pins, then install 2 tie bars, after that, wind the mounting rope, finally, fix the mounting trolley, refer to

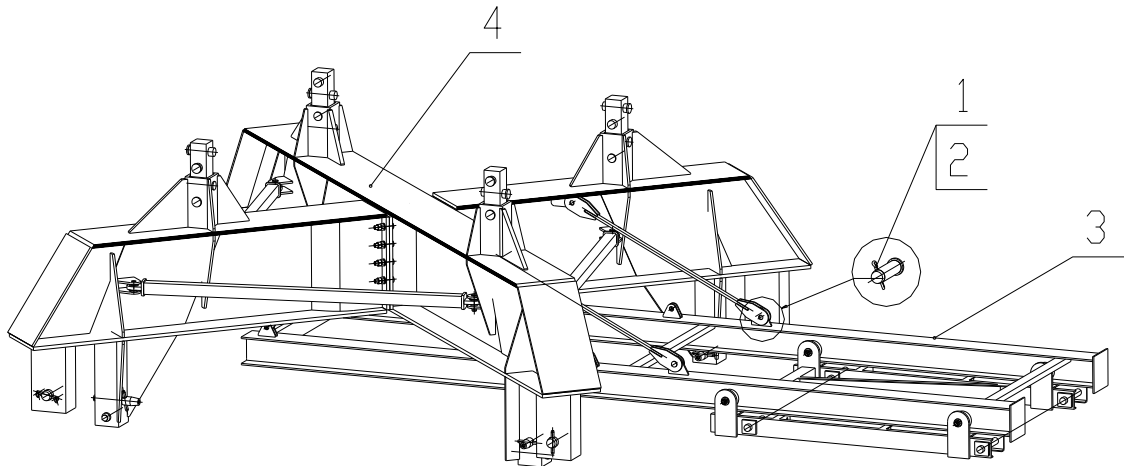


Fig. 4-18 Connecting the mounting device and transition beam

Table 4-18 Parts for connecting the mounting device and transition beam

No.	Designation	Specification	Qty
1	Pin	XZ01C-35×70/95	4
2	Split pin 8×71	GB/T91-2000	4
3	Mounting device		1
4	Transition beam		1

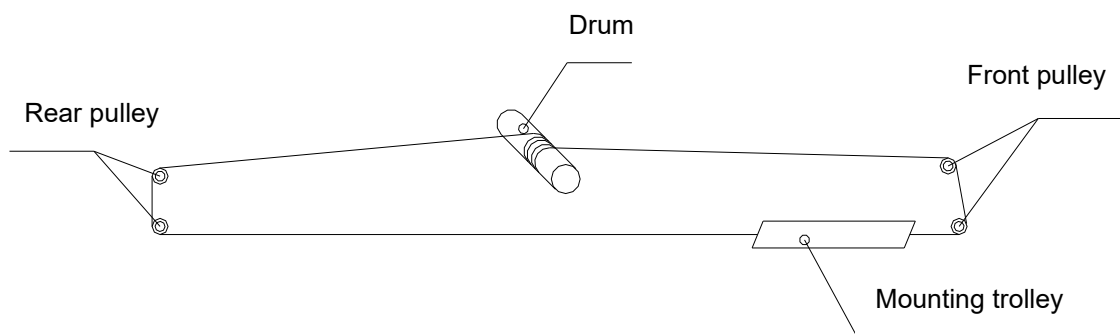


Fig. 4-19 Winding the mounting rope

4.7.4 Installing the mounting device and transition beam

Start the climbing hydraulic cylinder slowly until the top connectors of the top tower section enter the connectors of the transition beam and there can insert connecting pins in. Then insert the connecting pins and matched lock pins, spring pins in. As shown in Fig. 4-20.

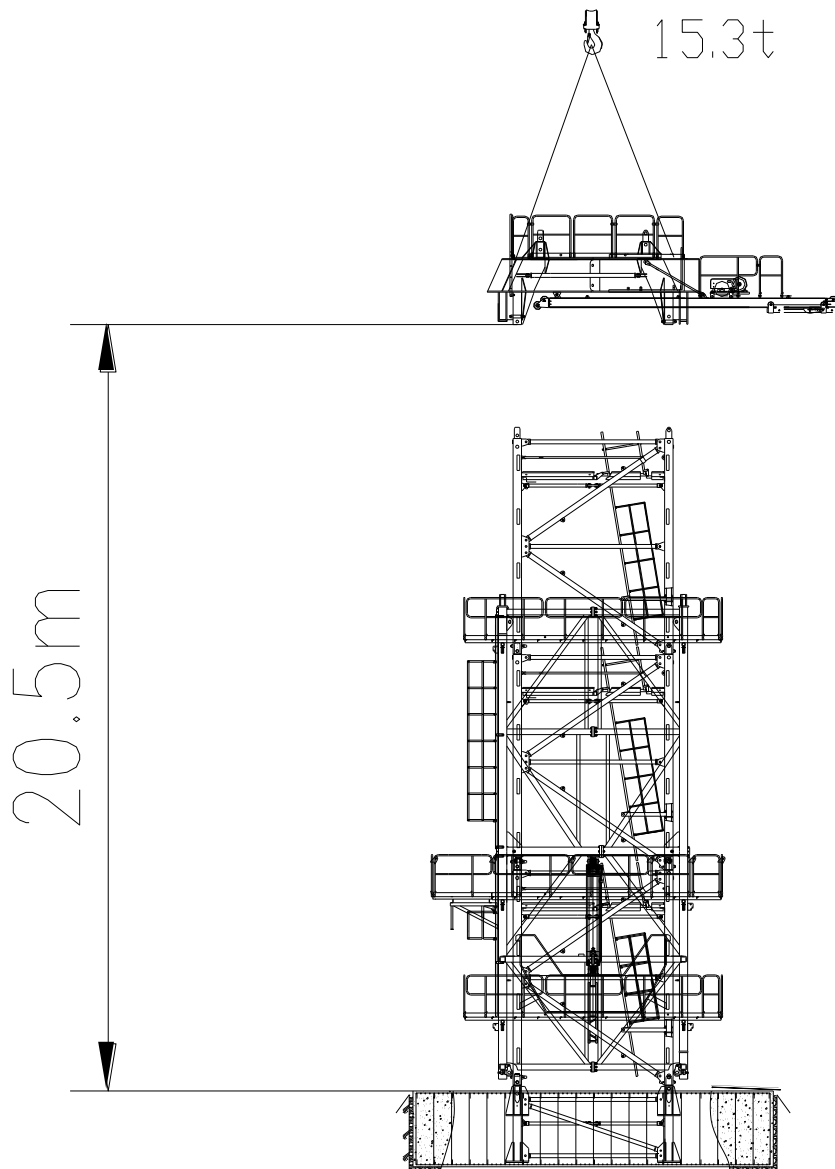


Fig. 4-20 Installing the mounting device and transition beam



Make sure the stretch part of the mounting beam is on the opposite side of the climbing steps of sections.

4.8 Installing the slewing unit

4.8.1 Description

The slewing unit consists of turntable, slewing ring, slewing support, slewing mechanisms, cabin resistor cabinet, and electric control cabinet. Generally, the turntable, slewing ring, and slewing support has been assembled well by the factory.

4.8.2 Assembling the turntable and platform

The turntable mainly consists of turntable structure, electric control cabinet and cabin platform. The electric control cabinet is on the left and the cabin platform is on the right, as shown in Fig. 4-21. They are connected with the turntable structure by pins of $\Phi 20$ (No. 18, 19 in Table 4-19).

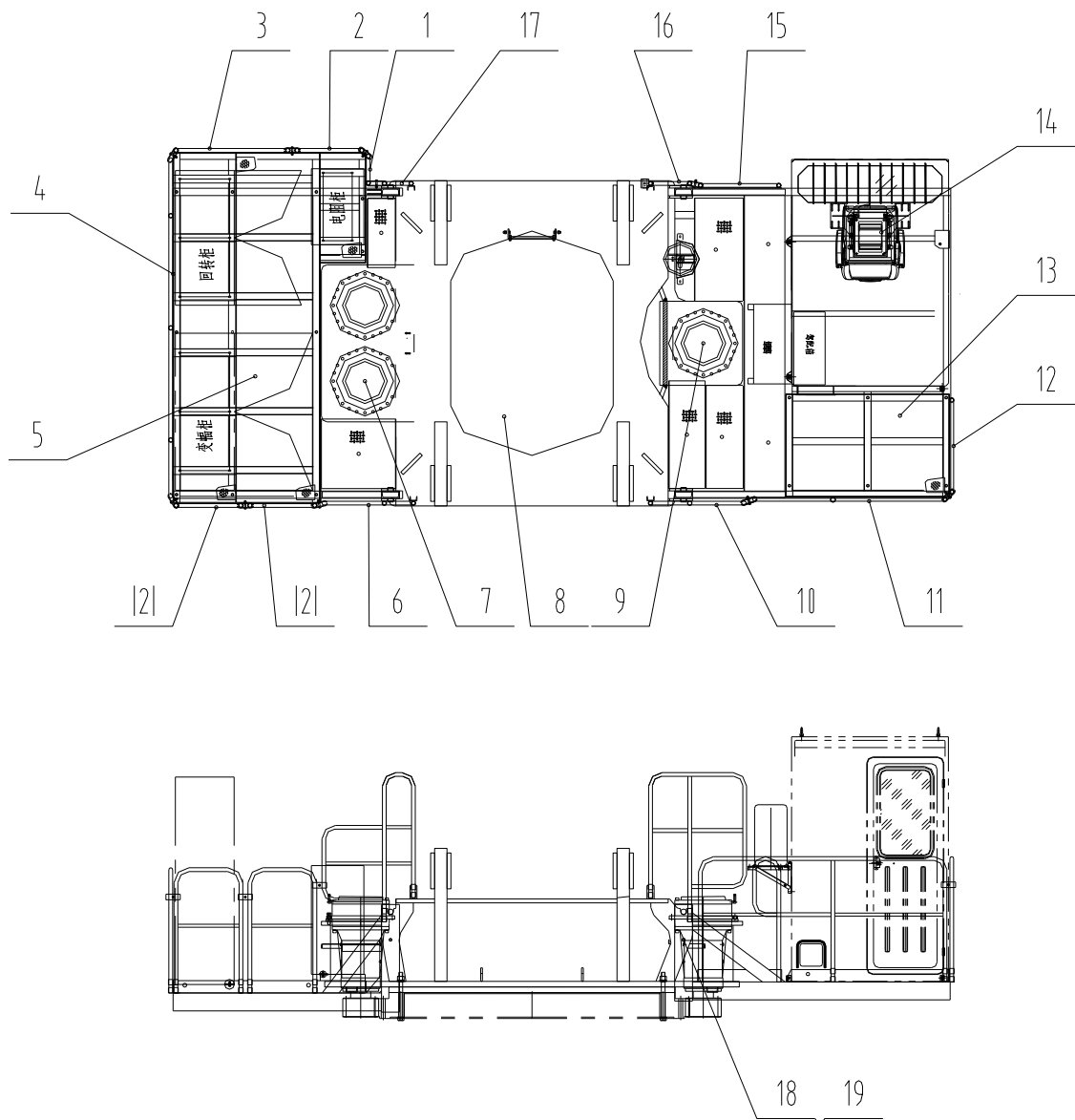


Fig. 4-21 Slewing unit

Table 4-19 Parts of slewing unit

No.	Designation	Specification	Qty
1	Non-standard railing		3
2	Railing	LGA580B	1
3	Railing	LGA1000C	1
4	Railing	LGB3000B	1
5	Electric control cabinet platform		1
6	Non-standard railing		1
7	Slewing mechanism I	S185CN-350.275CD20-13B	2
8	Turntable structure		1
9	Slewing mechanism II	S185CA-350.275CD20-13B	1
10	Non-standard railing		1
11	Non-standard railing		1
12	Railing	LGA820B	2
13	Cabin platform		1
14	Cabin	CM7	1
15	Railing	LGA700B	1
16	Non-standard railing		1
17	Non-standard railing		1
18	Pin	20×120	4
19	Spring pin		4

4.8.3 Installing the slewing mechanisms

Install the slewing mechanisms to the turntable structure by **72** sets of **M24×90** bolt.

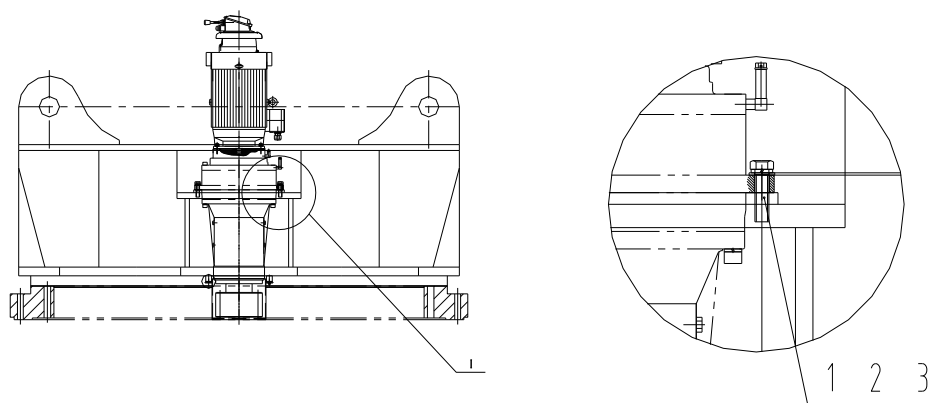


Fig. 4-22 Installing the slewing mechanisms

Table 4-20 Parts of installing the slewing mechanisms

No.	Designation	Specification	Qty
1	Washer	24-200HV	72
2	Washer	24	72
3	Bolt	M24×90-8.8	72

4.8.4 Attentions about slewing ring

Generally, the turntable, slewing ring, and slewing support are assembled well, but you should know the attentions below for maintenance.

- Bolt sets of the slewing ring
 - The high-strength bolts are **M33×370 (level 10.9)** and the preload moment shall be **2000~2200 N·m (without grease oil)**.
 - Use flat washers which need hardening and tempering. Spring washers could not be used.
- Installing the bolt sets of the slewing ring
 - Before installing, clean the erecting datum plane of slewing ring and the erecting plane of yoke, and wipe off wet fouling, burr, paint, and other foreign impurity.
 - During installing, the sign “S” and the hole with steel ball blocking should be placed less under load area or no-load area (That is, the slewing ring near the installation place).

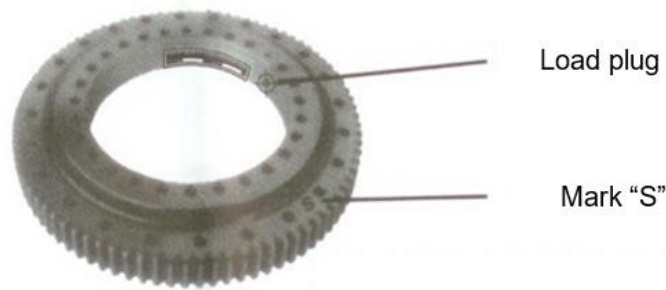


Fig. 4-23 Soft belt of the slewing ring

Screw down the high-strength bolts in the direction of 180° symmetrically and continuously. Make sure the preload moments on screw bolts are equal.

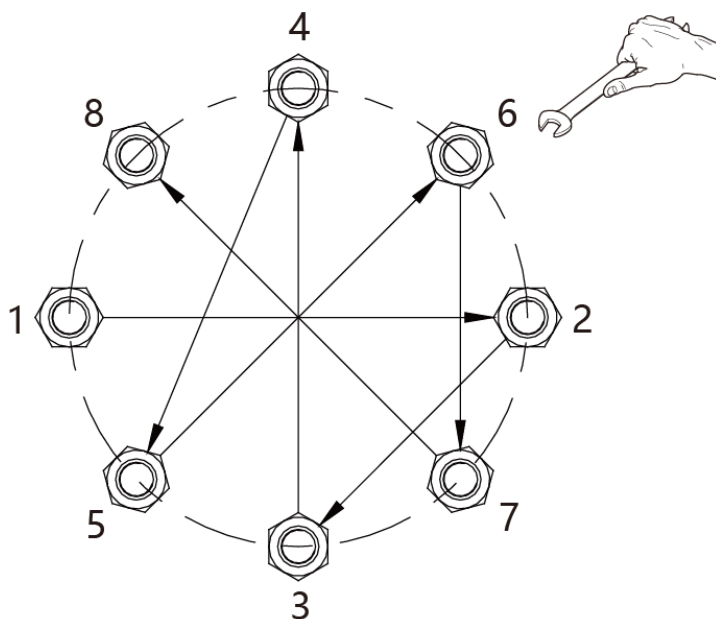


Fig. 4-24 The sequence of screwing down bolts

- Lubrication and maintenance
 - Add grease into slewing ring regularly. Shorten the period of greasing in special working condition such as in tropic, big humidity, too much dust and big range of temperature changing. Add enough new grease before and after tower crane out of working over a long period.
 - Check the preload moment of bolts when slewing ring is in service for 100 hours. Then check it once more after every 500 hours working time, ensuring there is enough preload.
 - Do not sluice slewing ring by water for fear that water get in.

4.8.5 Installing

Hoist down the slewing unit slowly to align the connectors of 4 main chords of the slewing support and the transition beam. Connect them by **8** pins of **Φ75**, refer to figure below.

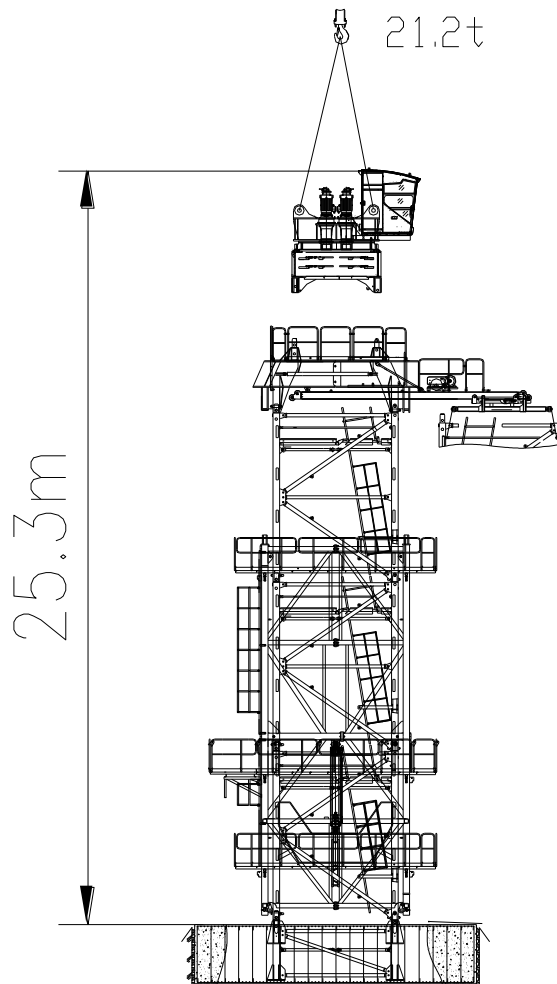


Fig. 4-25 Installing slewing unit



The ladder directions of slewing support and tower section must be the same.

4.9 Installing the jib and counter jib

4.9.1 Jib description

4.9.1.1 Jib combination

The whole jib can be assembled to be lengths of 80m, 75m, 70 m, 65m, 60m, 55m, 50 m, 45m, 40m, 35m, and 30m, the corresponding information of assembly of the rest jib sections are:

■ Jib combinations

Table 4-21 Jib combinations of different jib lengths

Jib part Jib length	Jib I	Jib II	JibIII	JibIV	Jib V	JibVI	JibVII	JibVIII	JibIX	Jib end
80m	•	•	•	•	•	•	•	•	•	•
75m	•	•	•	•	•	•	•	•	×	•
70m	•	•	•	•	•	•	•	×	•	•
65m	•	•	•	•	•	•	•	×	×	•
60m	•	•	×	•	•	•	•	×	×	•
55m	•	•	•	•	•	•	×	×	×	•
50m	•	•	×	•	•	•	×	×	×	•
45m	•	•	•	•	•	×	×	×	×	•
40m	•	•	×	•	•	×	×	×	×	•
35m	•	•	•	•	×	×	×	×	×	•
30m	•	•	×	•	×	×	×	×	×	•



Refer to **Section 7.3** for the order number of each jib section.

4.9.1.2 Connecting pins' dimensions

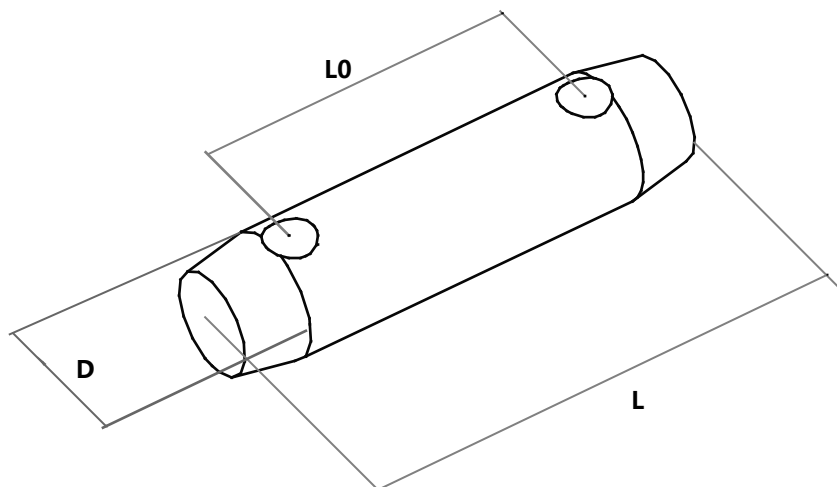


Table 4-22 Pins used to connect the upper and bottom chords of each adjacent jib

Position	Upper chord pin				Bottom chord pin			
	D [mm]	L0 [mm]	L [mm]	Qty.	D [mm]	L0 [mm]	L [mm]	Qty.
Jib I & Jib II	Φ160	335	375	2	Φ60	299	345	2
Jib II & Jib III	Φ140	315	355	2	Φ60	267	315	2
Jib III & Jib IV	Φ140	300	340	2	Φ60	245	290	2
Jib IV & Jib V	Φ150	335	375	1	Φ60	236	267	2
Jib V & Jib VI	Φ150	280	345	1	Φ45	209	240	2
Jib VI & Jib VII	Φ150	275	355	1				2
Jib VII & Jib VIII	Φ90	238	295	1	Φ45	171	200	2
Jib VIII & Jib IX	Φ90	155	210	1	Φ45	154	185	2
Jib IX & Jib end	Φ90	114	165	1	Φ45	137	167	2

4.9.2 Assembling jib I and jib II

Prepare 2~3 steel supports which's height is over 2m and width is not less than 2.5m. There are lifting lugs on each jib section for hoisting.

4.9.2.1 Assembling jib I

The jib I is quadrangle truss structure. There are connecting lugs for connecting jib II and the front counter-jib on the upper chords. It connects to the turntable by 4 pins of $\Phi 130$ at the bottom. There are platforms on both the upper and the bottom for installing and maintenance. Insert the railings to the railing seats, fix them by split pins of 8×71 , and fix the railings together by splint railings and bolts of $M12 \times 70$.

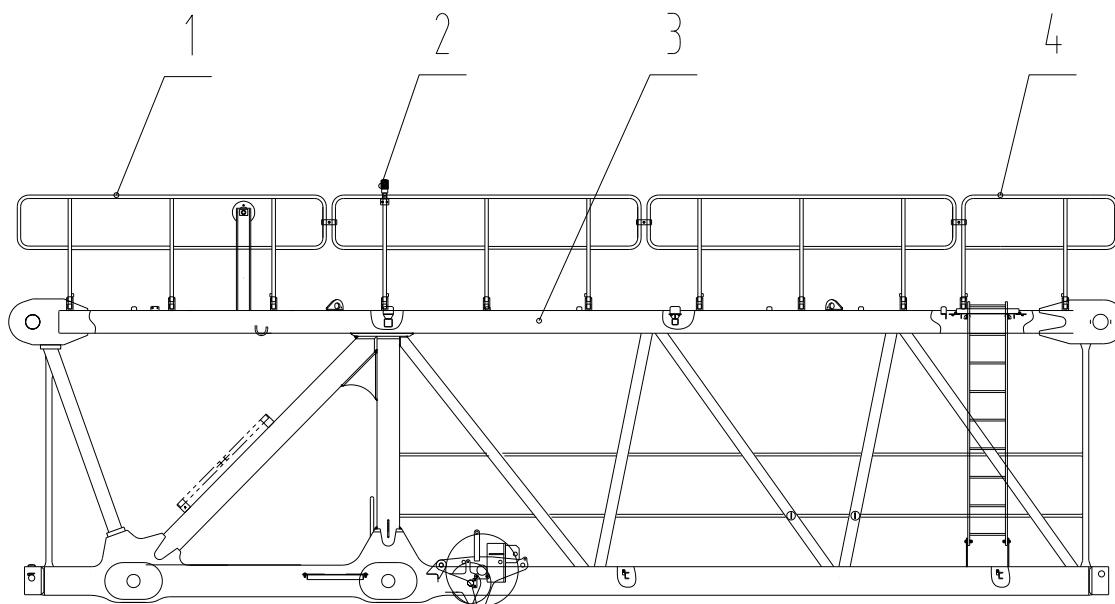


Fig. 4-26 Assembling jib I

Table 4-23 Parts for assembling jib I

No.	Designation	Specification	Qty
1	Railing	LGB3000B	6
2	Obstacle light seat		1
3	Jib I structure		1
4	Railing	LGC1500B	2

4.9.2.2 Assembling jib II

The jib II is quadrangle truss structure. There are connecting lugs for connecting jib III on the upper chords. There are platforms on both the upper and the bottom for installing and maintenance. Insert the railings to the railing seats, fix them by split pins of **8×71**, and fix the railings together by splint railings and bolts of **M12×70**.

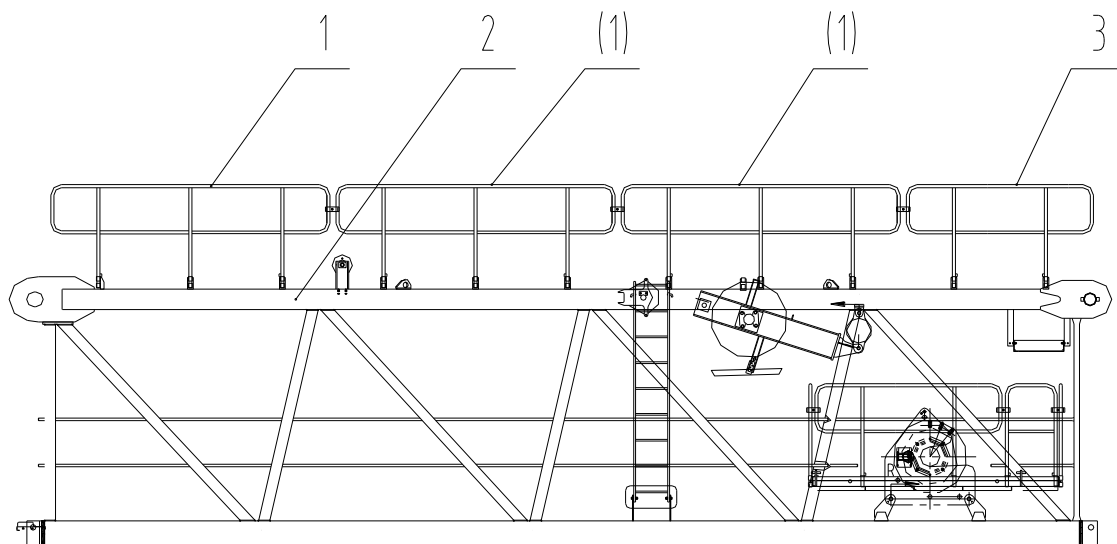


Fig. 4-27 Assembling jib II

Table 4-24 Parts for assembling jib II

No.	Designation	Specification	Qty
1	Railing	LGB3000B	6
2	Jib II structure		1
3	Railing	LGC2000B	2

4.9.2.3 Assembling the trolley

The trolley is double-trolley type, it has a main trolley and an auxiliary trolley. Install the trolley to tracks on the jib form jib I . Here are some structure explaining:

- 1) There are riding wheels to avoid hoisting rope or trolley rope wearing the trolley frame when the tower crane is out of service.
- 2) There is anti-rope-breaking device to avoid trolley sliding if trolley rope broken.
- 3) There are side rollers to ensure the trolley move normally.
- 4) There are hanging beams to ensure the trolley reactions are balance and wheel pressures are normal.
- 5) There are operation platform and ladder for fall-changing operation.

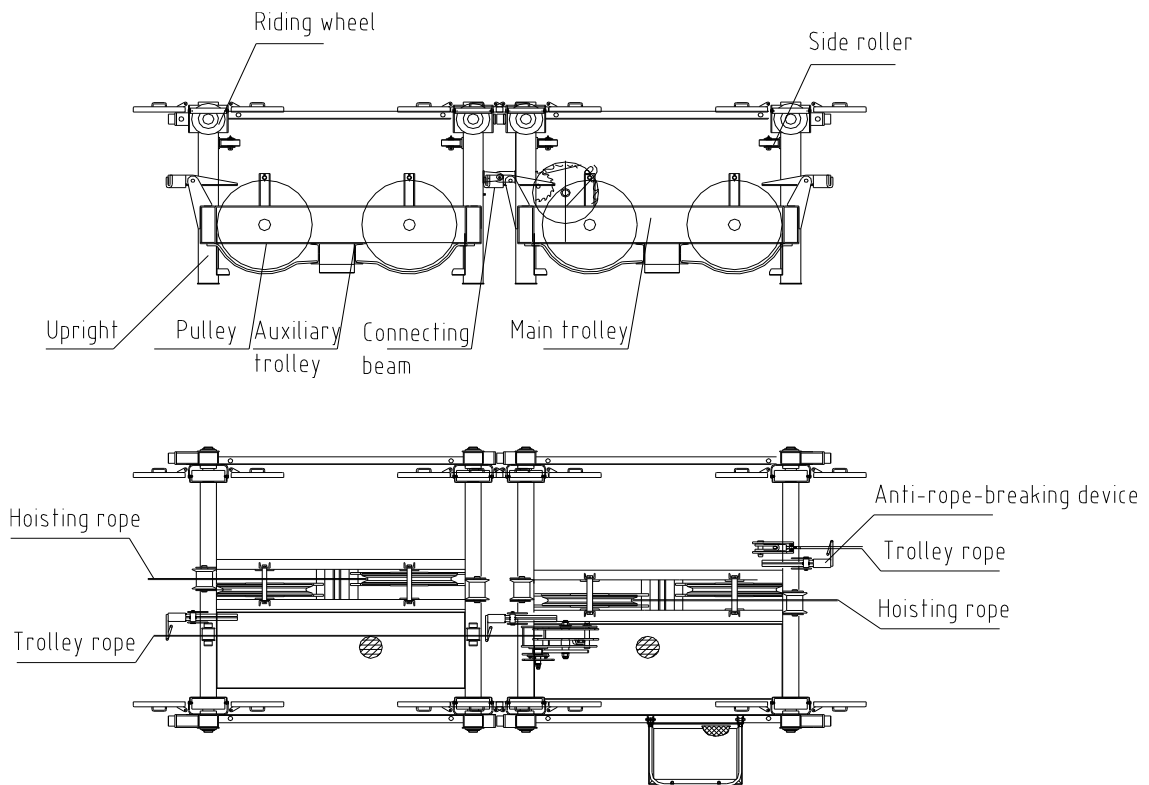


Fig. 4-28 Trolley structure

4.9.3 Installing jib I

Install jib I to turntable by 4 pins of **Φ75**, as shown in Fig. 4-29.

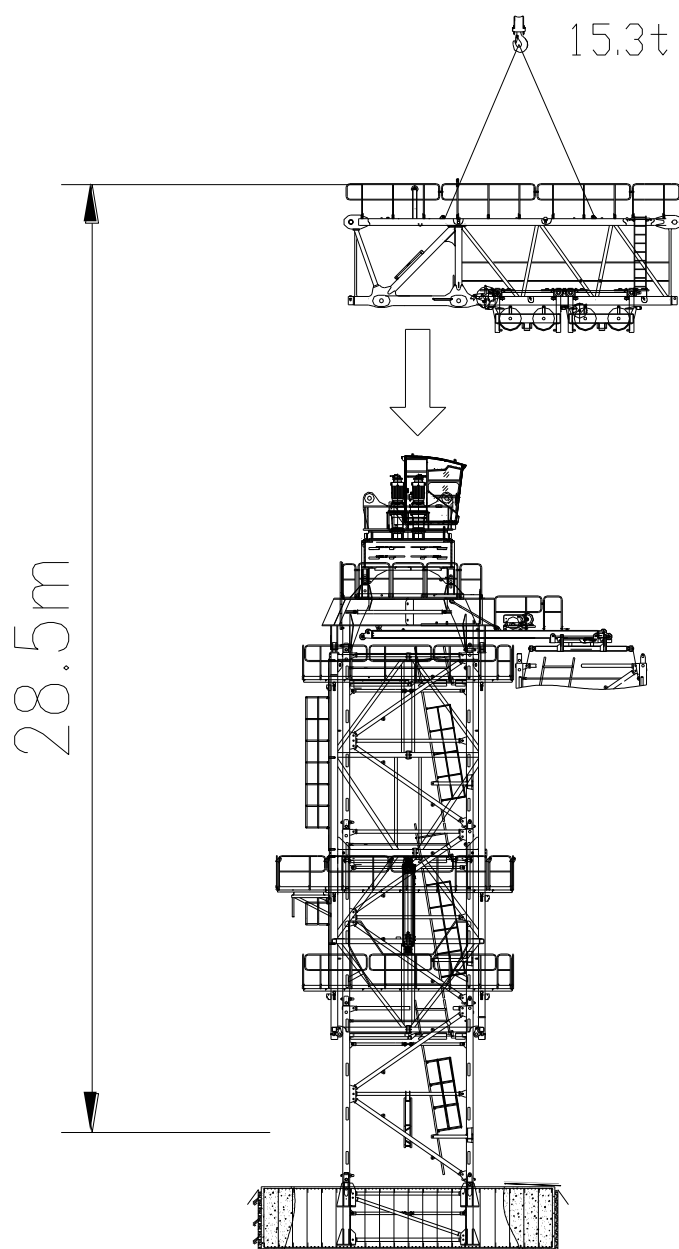


Fig. 4-29 Installing jib I

4.9.4 Installing jib II

Install jib II to jib I by 2 pins of **Φ160** on the top, and 2 pins of **Φ60** at the bottom, as shown in Fig. 4-29.

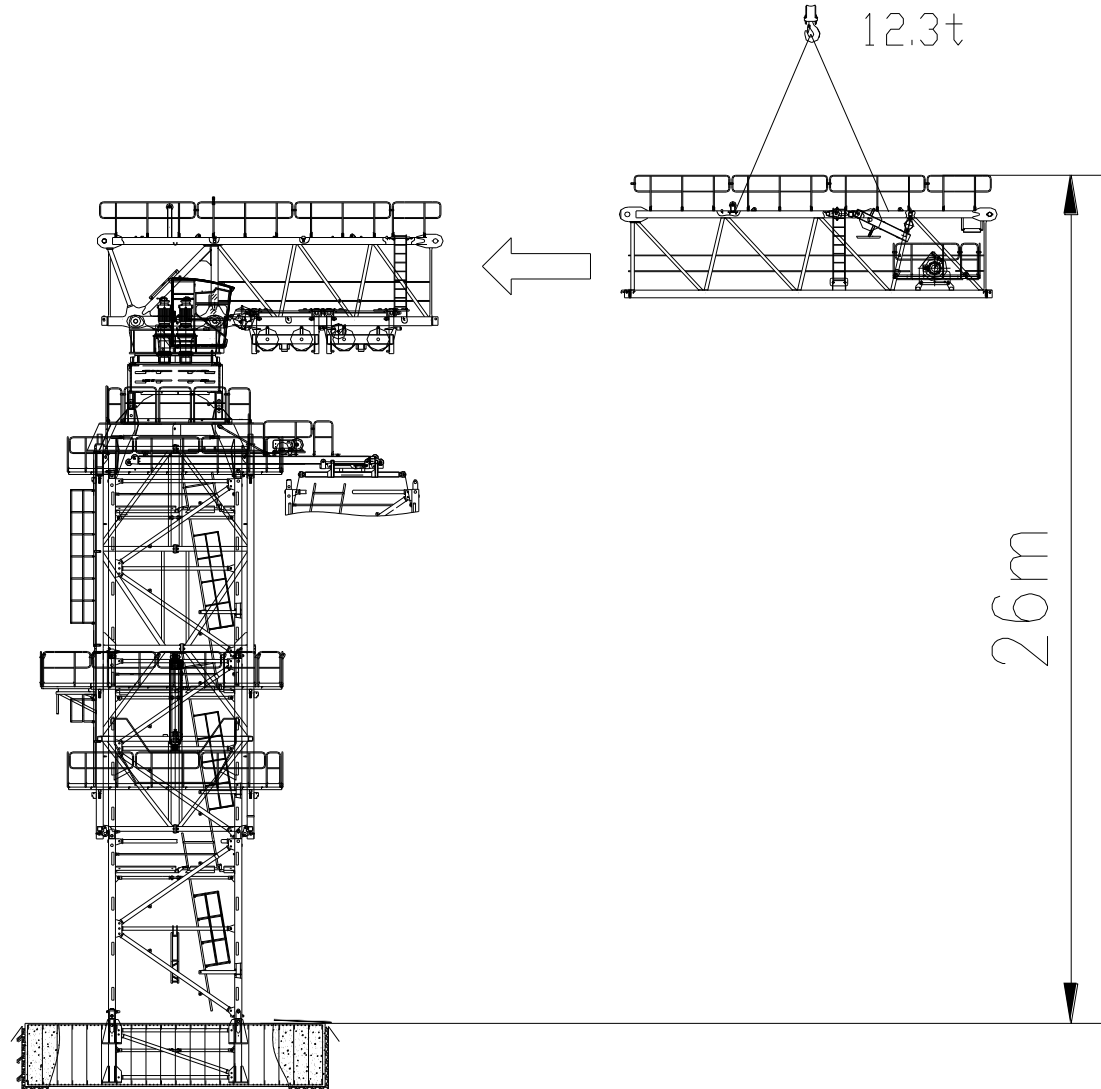


Fig. 4-30 Installing jib II

4.9.5 Assembling the counter jib

The inside platforms and auxiliary hoisting mechanism have been installed to the counter jib, the users only need to install the counter jib structure, outside platforms, and railings.

4.9.5.1 Assembling the counter jib structure

The structure of front, middle, rear counter-jibs are quadrangle truss structure, users need to connect the upper chords by $\Phi 140$ pins and bottom chords by $\Phi 60$ pins, and insert lock pins and spring pins to the main pins' both ends, as shown in Fig. 4-31.

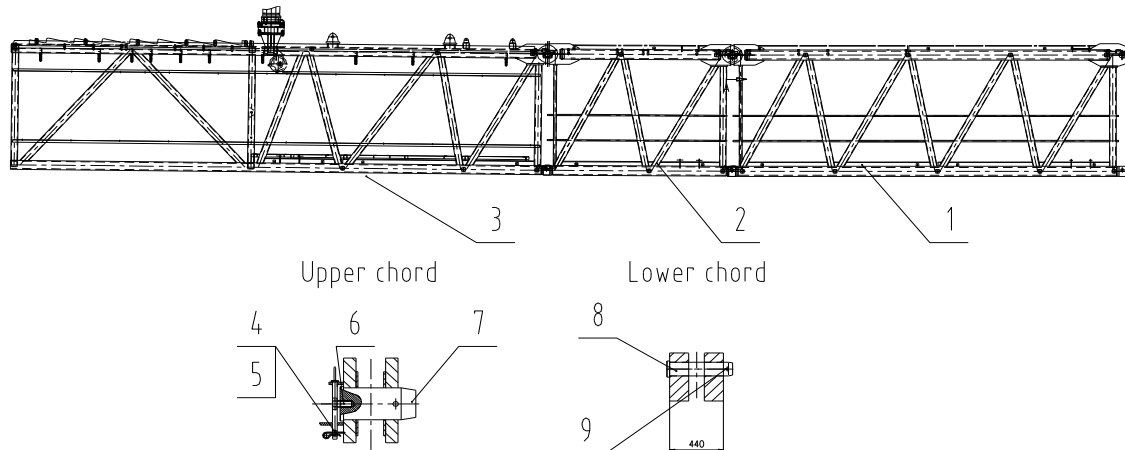


Fig. 4-31 Assembling the counter jib structure

Table 4-25 Parts for assembling the counter jib structure

No.	Designation	Specification	Qty
1	Front counter-jib structure		1
2	Middle counter-jib structure		10
3	Rear counter-jib structure		40
4	Safety pin		6
5	Spring pin		6
6	Bolt	M30×60-8.8	6
7	Pin	140×210/310	6
8	Pin	60×235	6
9	Split pin	10×100	6

4.9.5.2 Assembling the front counter-jib

The front counter-jib is quadrangle truss structure. There are connecting lugs for connecting jib I and the middle counter-jib on the upper chords. There are platforms on both the upper and the bottom for installing and maintenance. Insert the railings to the railing seats, fix them by split pins of **8×71**, and fix the railings together by splint railings and bolts of **M12×70**.

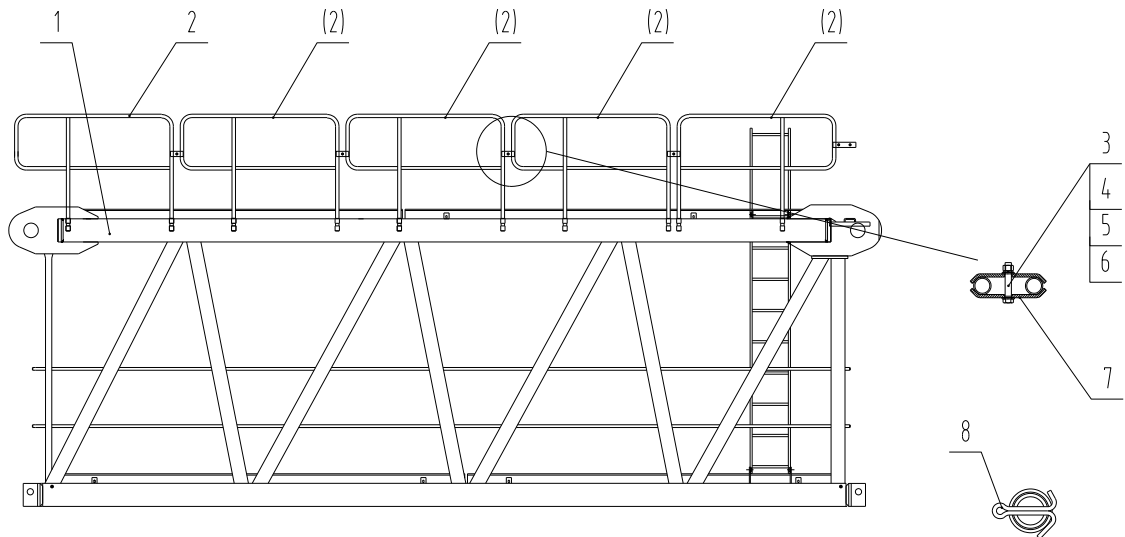


Fig. 4-32 Assembling the front counter-jib

Table 4-26 Parts for assembling the front counter-jib

No.	Designation	Specification	Qty
1	Front counter-jib structure		1
2	Railing	LGC1500A	10
3	Nut	M12-8	40
4	Washer	12	88
5	Washer	12-200HV	122
6	Bolt	M12×70-8.8	12
7	Railing splint	t6	16
8	Pin	8×71	20

4.9.5.3 Assembling the middle counter-jib

The front counter-jib is quadrangle truss structure. There are connecting lugs for connecting front counter-jib and the rear counter-jib on the upper chords. Insert the railings to the railing seats, fix them by split pins of **8×71**, and fix the railings together by splint railings and bolts of **M12×70**.

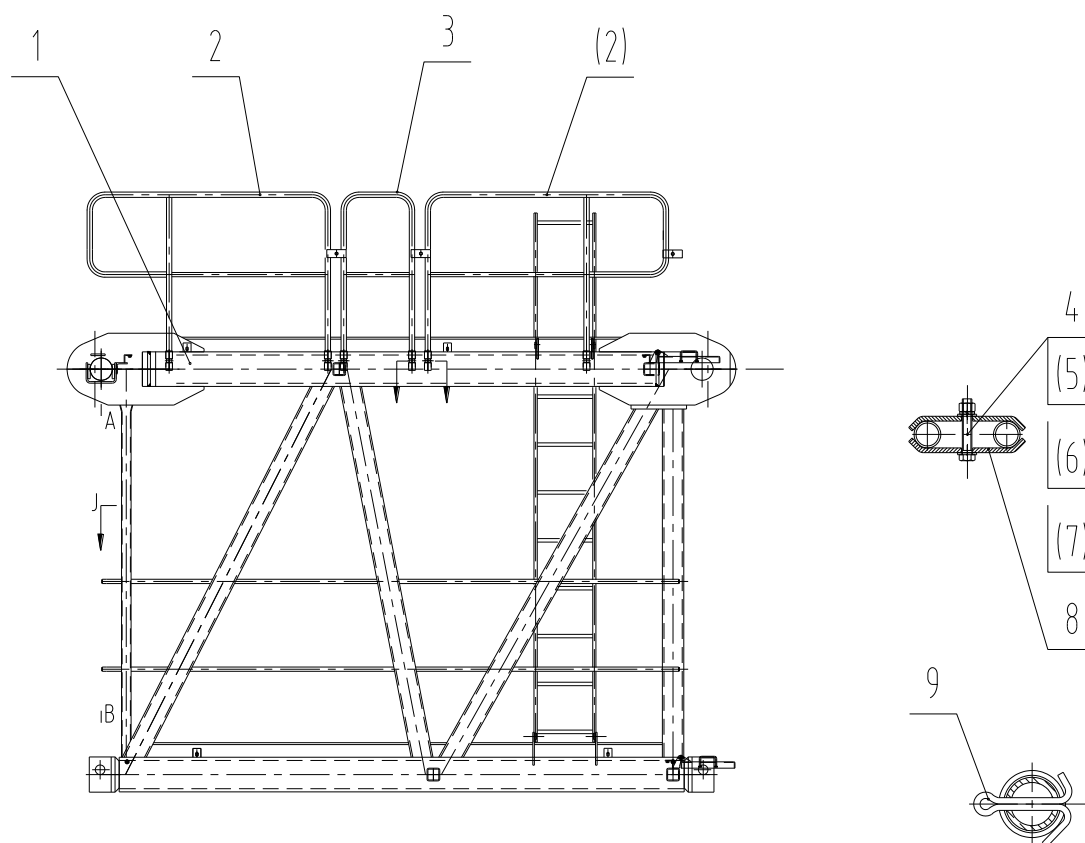


Fig. 4-33 Assembling the middle counter-jib

Table 4-27 Parts for assembling the middle counter-jib

No.	Designation	Specification	Qty
1	Middle counter-jib structure		1
2	Railing	LGC1500A	4
3	Railing	LGA430A	2
4	Bolt	M12×50-8.8	6
5	Nut	M12×70-8.8	24
6	Washer	12	50
7	Washer	12-200HV	72
8	Railing splint	t6	12
9	Pin	8×71	12

4.9.5.4 Assembling the middle counter-jib

The front counter-jib is quadrangle truss structure. The upper part is the place where installing the hoisting mechanism and derrick, the rear part is the place where installing the counter ballasts.

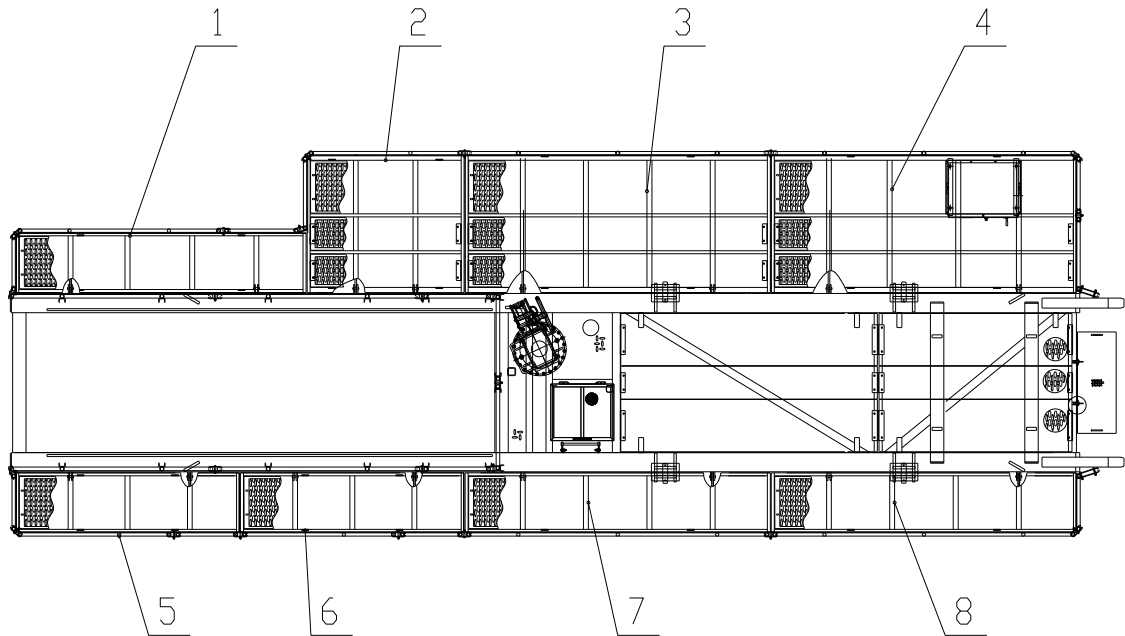


Fig. 4-34 Assembling platforms of the rear counter-jib

Table 4-28 Parts for assembling platforms of the rear counter-jib

No.	Designation	Specification	Qty
1	Platform I		1
2	Platform II		1
3	Platform III		1
4	Platform IV		1
5	Platform V		1
6	Platform VI		1
7	Platform VII		1
8	Platform VIII		1

After installing the platforms, insert the railings to the railing seats, fix them by split pins of **8×71**, and fix the railings together by splint railings and bolts of **M12×70**.

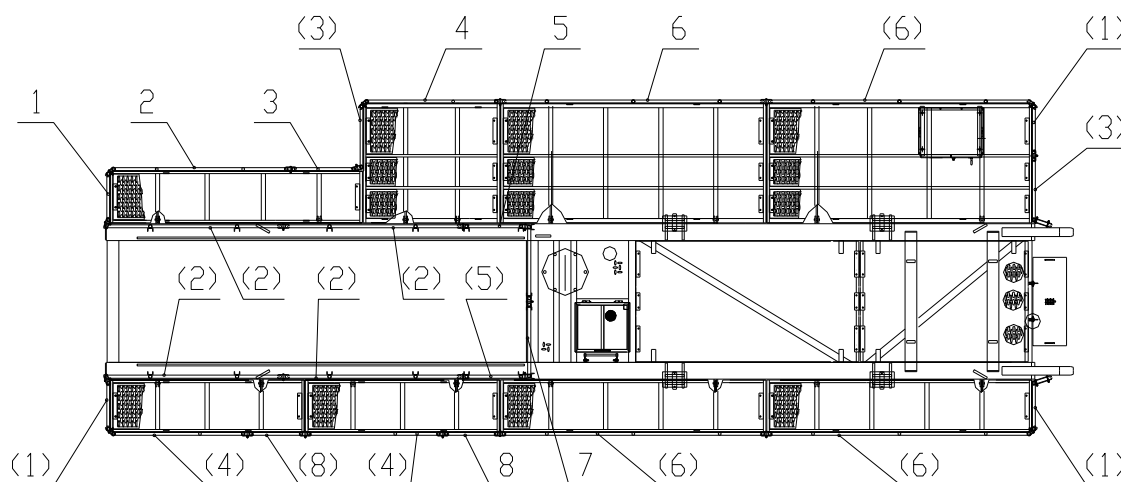


Fig. 4-35 Assembling the middle counter-jib

Table 4-29 Parts for assembling the middle counter-jib

No.	Designation	Specification	Qty
1	Railing	LGA530A	4
2	Railing	LGB2000A	5
3	Railing	LGA700A	3
4	Railing	LGC1500A	3
5	Railing	LGA630A	2
6	Railing	LGB3000A	4
7	Railing	LGA820A	2
8	Railing	LGA580A	2

4.9.6 Installing the counter jib

After installing the platforms and railings, hoist the counter jib to the installing height, make the rear part upwarp a little* to install the 2 pins of **Φ140** on the upper chord of front counter-jib. After install the 2 pins, let the rear part down slowly and rotate around the 2 pins until the pin holes of bottom chords of the front counter-jib and jib I touches each other. Then insert the 2 pins of **Φ60** of the bottom chords, and insert split pins of **10×100**, and fix the railings together by splint railings and bolts of **M12×70**.

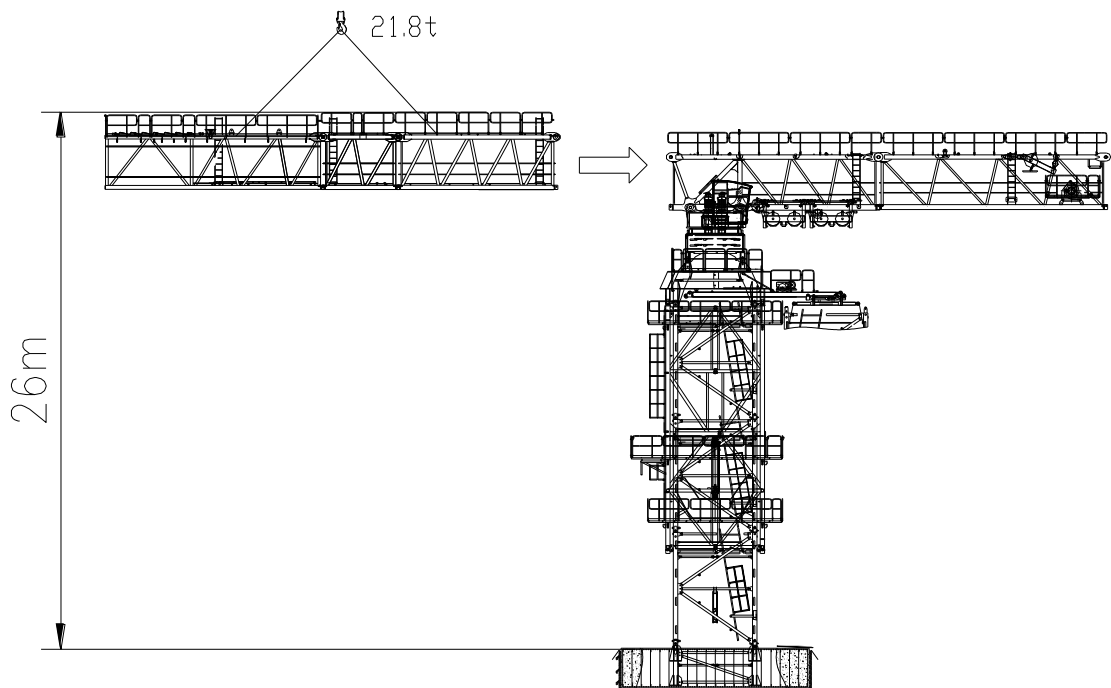


Fig. 4-36 Installing the counter jib



Don't upwarp the rear part of counter jib for too much, otherwise, the railings of counter jib and jib I may intervene each other.

4.10 Installing the hoisting mechanism

Lift the hoisting mechanism to the 4 installing lugs on rear counter-jib, fix it to the lugs by 4 pins of $\Phi 140$, and 4 split pins of 10×100 .

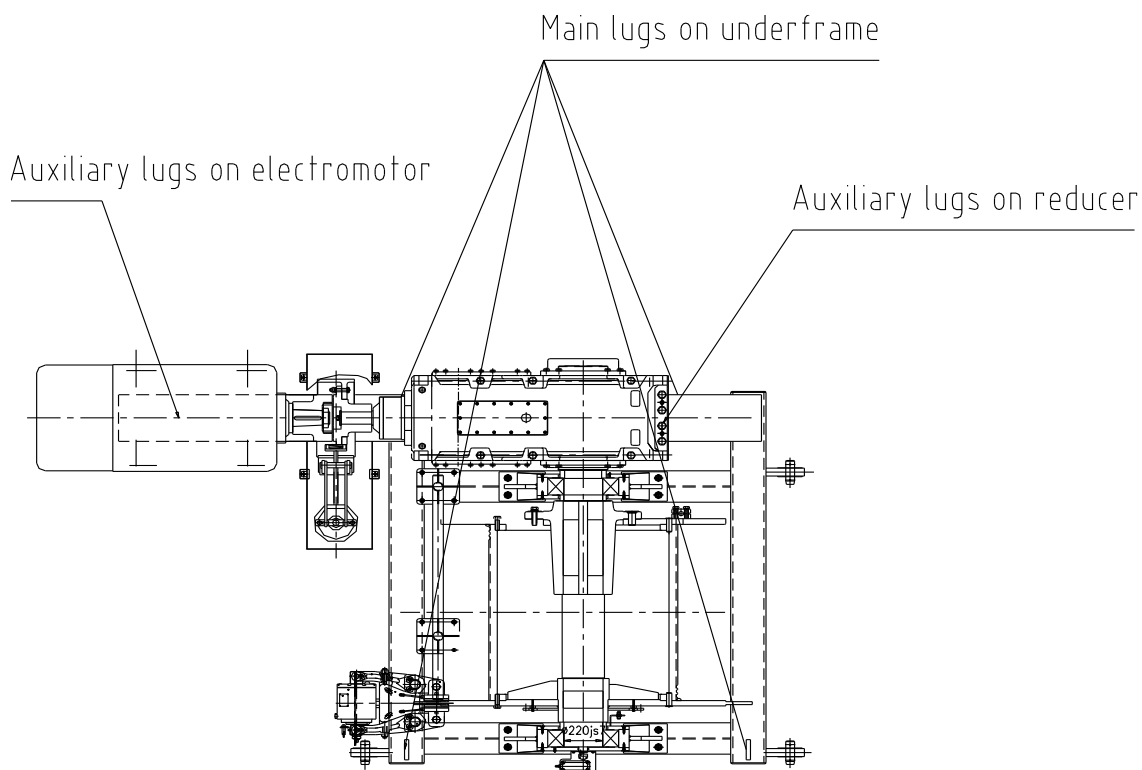


Fig. 4-37 Lifting lugs of the hoisting mechanism



Use proper lifting lugs and adjust lifting ropes to make the hoisting mechanism be hoisted horizontally.

4.11 Installing the derrick

The derrick is used for lifting or maintenance the hoisting mechanism. Install it to the installing seat on rear counter-jib by 6 sets of **M30×110-8.8** bolts. It can be installed by the counter jib or after the counter jib installed.

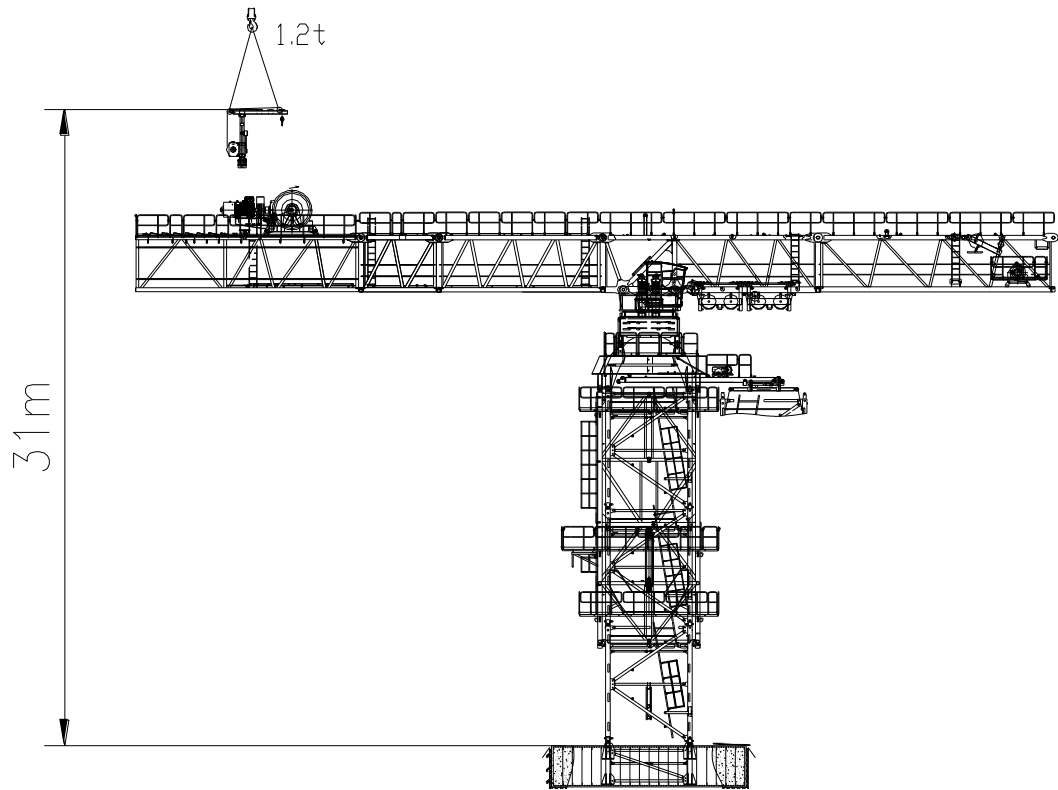


Fig. 4-38 Installing the derrick

4.11.1 Preload moment

The rated preload moment of the **M30** bolts is 1300N-m, check the moment for every 300 hours.

4.11.2 Check and adjusting of the structure

Check if there is any crack, permanent transforming, or paint falling on each spare part (refer to **Section 7.5**) before using, if yes, repair or replace it.

At the using process, check all the parts regularly, and check if there is any loosening, cracks, or abnormal states on bolts or pins, deal with the problems in time.

4.11.3 Check and adjusting of the mechanism

- 1) Check the rotating ring of the rotating seat before using, confirm the lubricating state, check if it rotating flexibly, if any noisy, and the bolt fixing state. If there is any abnormal state, deal with that in time;
- 2) Check the breaking and lubricating degree of bearing and rope of the luffing mechanism, luffing trolley, sling, and pulleys. If the lubricating oil decrease or used up, add or paint the oil.
- 3) Check the whole derrick before using or in using process, check if the rotating parts is flexible, if any noisy, if the rope is worn, check the bolts connecting state. If there is any abnormal state, deal with that in time;



- Use the derrick by rated load, it's forbidden to overload.
- The sling can only lift load vertically, it's forbidden to lift load aslant or drag load flatly.
- It's forbidden to stand under the lifting load for any person.
- It's forbidden to hang the load for a long time.



- *The derrick must be operated by professional persons, the operator must know the structure and property, and know the safety instruction well.*
- *When the sling lift to the highest point, be careful to operate, DON'T make the sling touch any parts on the top; when the sling descends, there must be at least 3 layers of rope on the drum of the auxiliary hoisting mechanism, and the sling can't touch the ground.*
- *Use locating pins to locate on the rotating seat (24 locating holes), it benefits for working at a fixed position, prevent free rotating when the wind is high.*

4.12 Installing the first counter ballast

Install a counter ballast of **12.5 t** to the first (jib side) counter ballast slot of rear counter-jib.

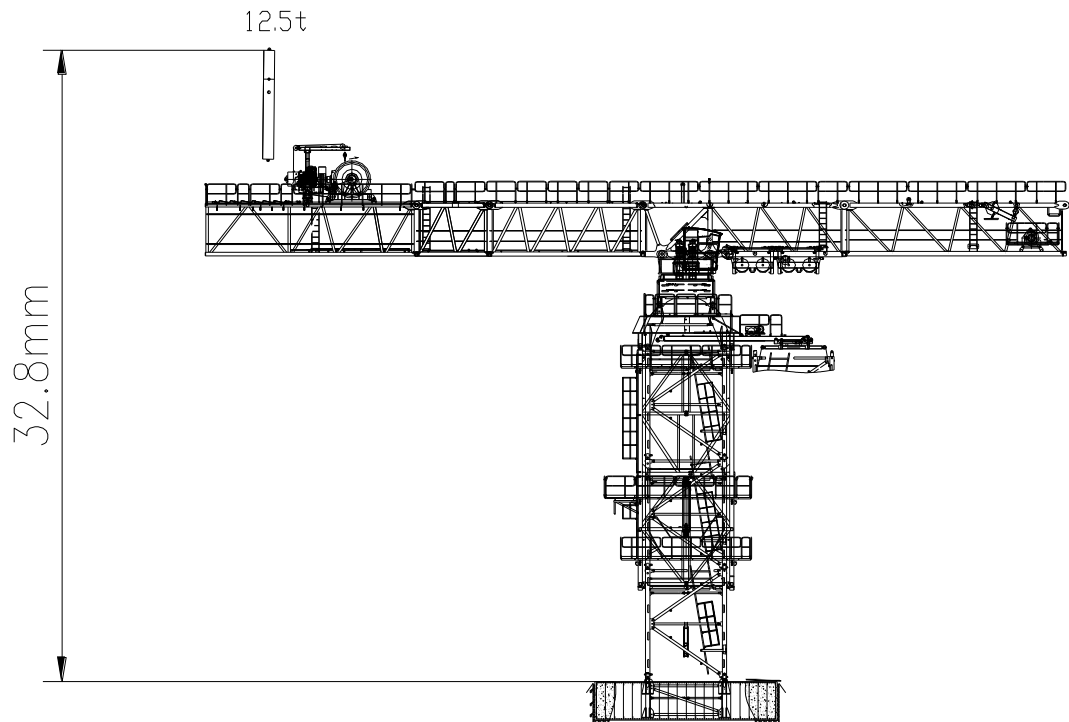


Fig. 4-39 Installing the first 12.5t counter ballast



- The counter ballast is placed by hoisting mechanism, positioned at the middle of left and right, the distance between the two sides of counter jib and the side chords is uniform.
- The pins of counter ballast must be beyond the support plate of the counter ballast.

4.13 Installing the assembly of the rest jib sections

4.13.1 Assembling

Prepare several brackets which's length are about 1.2m near the tower crane, for the jib above 50m shall not be less than 4, and for the jib not more than 50m shall not be less than 3. Assemble the rest jib sections according to **Section 4.9.1**, refer to Fig. 4-40.

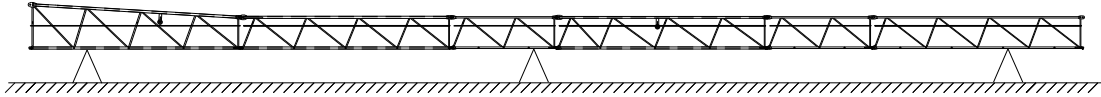


Fig. 4-40 Assembling jib



- Assemble the jib according to the sequence mark on each section strictly, it's forbidden to install them mistakenly or randomly.
- The trolley mechanism motor is on the opposite side of the cabin.
- No matter how long the jib is, the trolley should be fixed on the guide rail of the bottom chord of the jib to prevent sliding.

4.13.2 Installing

- 1) Operating the slewing mechanism and make it running or use the crank of slewing mechanism to rotate the upper structure of tower crane to the position where the jib can be conveniently installed.
- 2) According to the center of gravity of the jib assembly of each jib length to hang the rope, as shown in Fig. 4-41 and Table 4-30. Try to test the hoist point whether balanced, otherwise the position of the hanging rope can be moved appropriately. The distance between the two hoist points is $8\text{m} \leq d \leq 20\text{m}$.

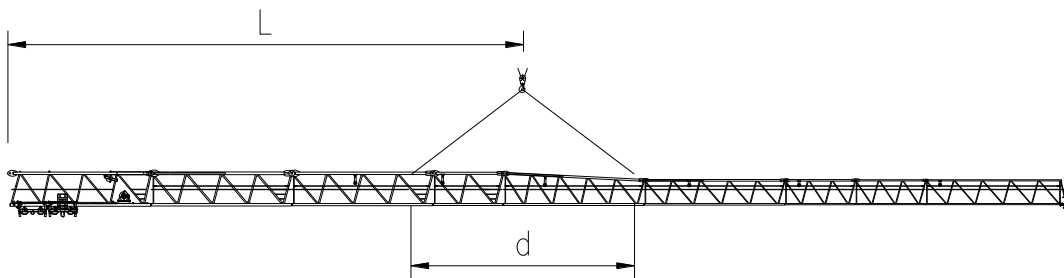


Fig. 4-41 Reference center of gravity of jib

Table 4-30 Reference center of gravity of jib with different lengths

Jib length/m	80	75	70	65	60	55
G/t	25.13	24.40	23.19	22.46	18.33	19.90
L/m	19.29	18.48	17.16	16.39	15.89	14.34
Jib length/m	50	45	40	35	30	/
G/t	15.77	16.36	12.23	11.80	7.67	/
L/m	13.08	11.50	9.81	7.84	6.15	/



- The above data are for reference and can be adjusted according to the actual situation on site.
- Record the place of hoisting point for the dismantling use.

3) Lift the rest jib assembly by rope, as Fig. 4-42, the figure 1, 2 are right, while the figure 3 is wrong.

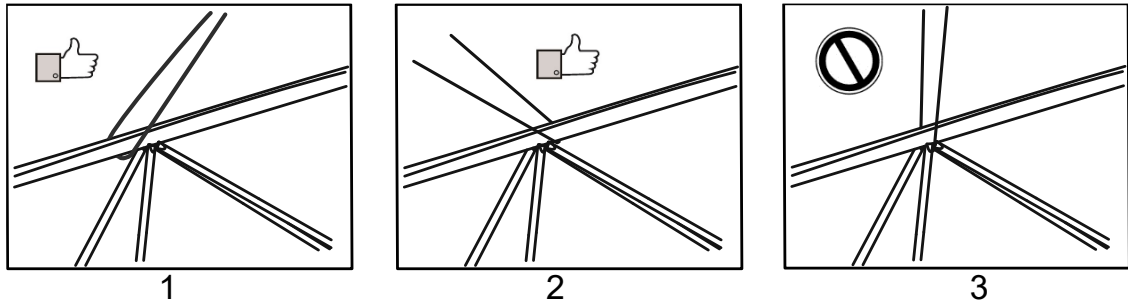
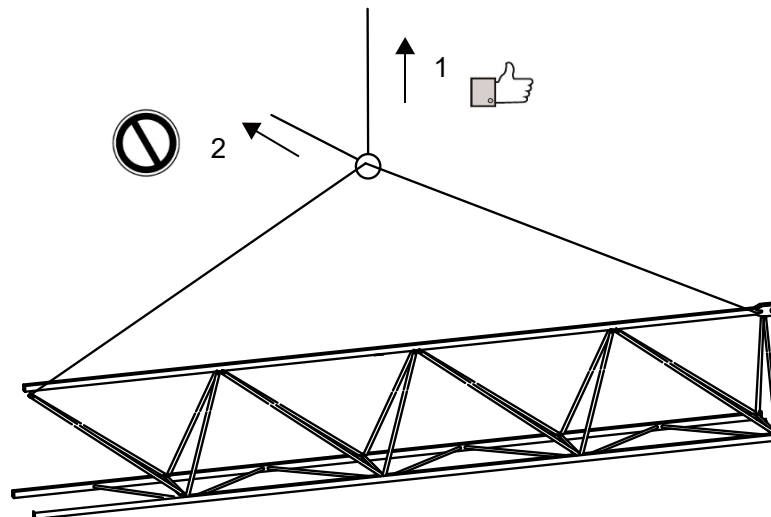


Fig. 4-42 Lifting rope winding way of the rest jib assembly

- It's forbidden to pull aslant when lifting the rest jib assembly, lift vertically, as



4) Hoist the rest jib assembly to mounting height, as shown in Fig. 4-43. Connect it to jib II by pins.

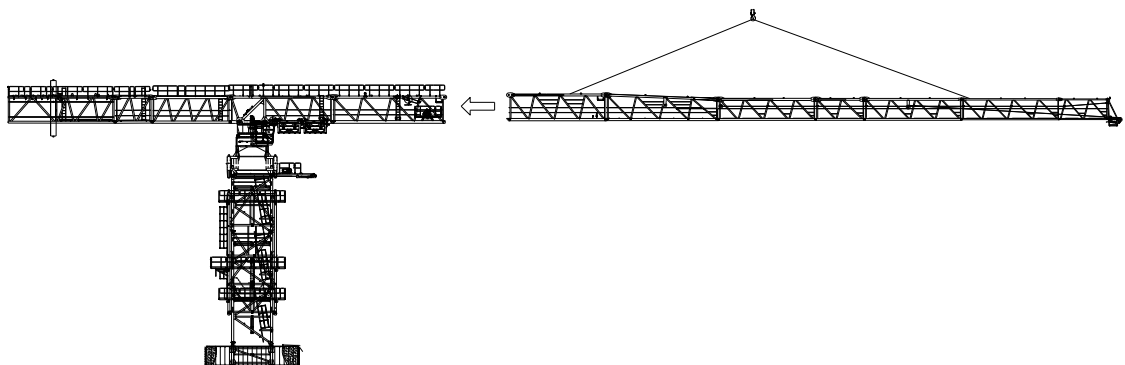


Fig. 4-43 Installing the rest jib assembly

4.14 Winding the trolley rope

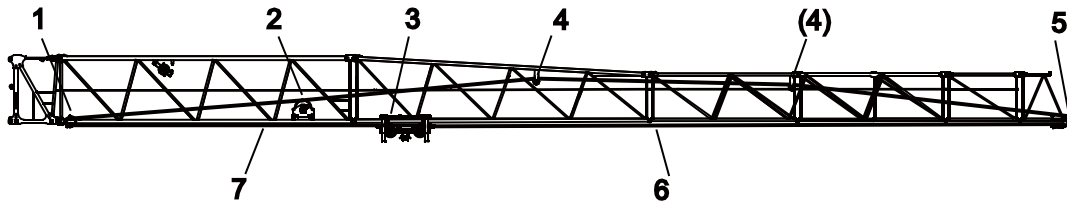


Fig. 4-44 Trolley wire rope layout plan

- | | |
|------------------------|-------------------------------|
| (1) Pulley on jib root | (2) Drum of trolley mechanism |
| (3) Trolley | (4) Rope rollers of jib |
| (5) Pulley on jib end | (6) Long rope |
| (7) Short rope | |



- When change the double trolleys to single trolley at 2-fall, take out the trolley rope in the safe room of the auxiliary trolley.
- The short and long ropes of trolley mechanism must have three circles of safety rope on the drum under any circumstances, and a circle of isolation rope should be left on the drum.
- When changing the length of jib, the excess rope is tied and fixed to the trolley.

4.15 Installing the rest counter ballasts

Install the rest counter ballasts according to the **Section 3.6.2**.



- Users have to choose a proper plate to cover the remaining empty after installing all the counter ballast.**
- After install all the counter ballast, please check carefully and make sure that all the counter ballast are fixed stable.**

4.16 Winding the hoisting rope

The winding ways of hoisting rope are shown in figures below:

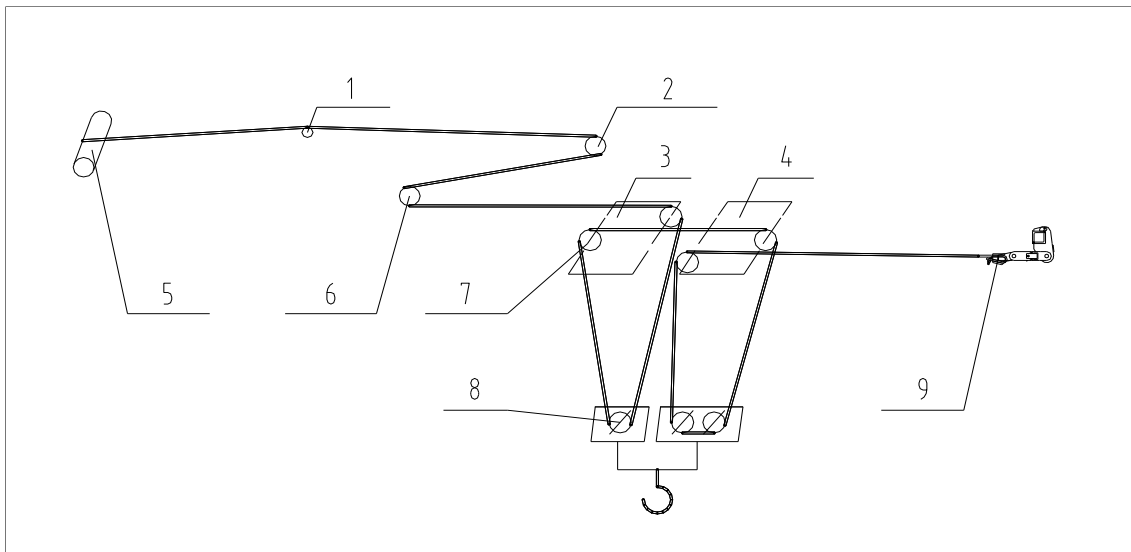


Fig. 4-45 Winding of the hoisting rope at 4-fall

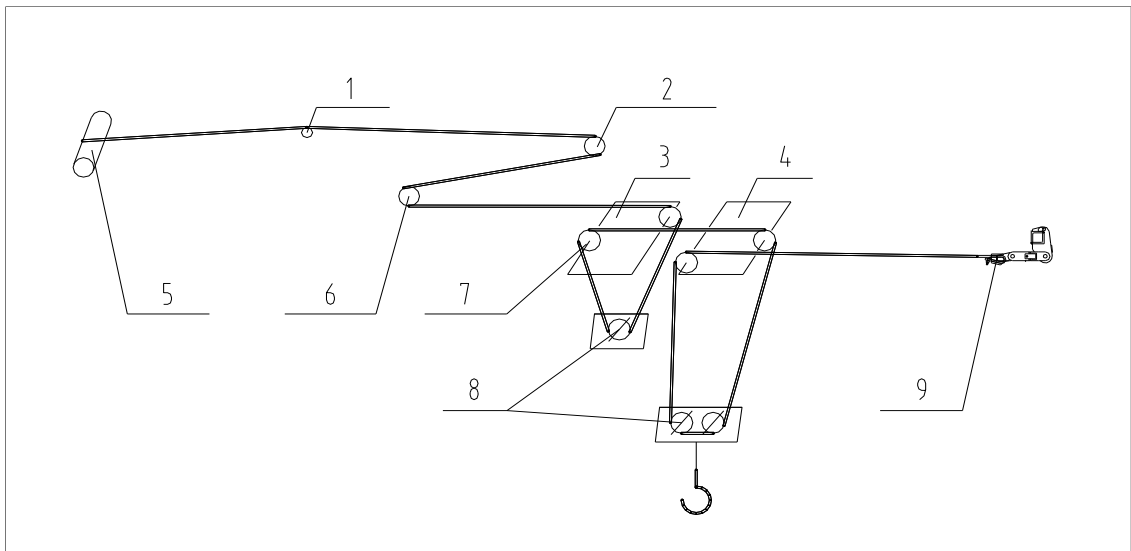


Fig. 4-46 Winding of the hoisting rope at 2-fall

- | | |
|-----------------------|---------------------|
| (1) Drum | (2) Roller |
| (3) Load limiter | (4) Jib root pulley |
| (5) Trolley | (6) Hook |
| (7) Anti-twist device | |

- 1) Fix the hook to the support (height 1.5m) on the ground as the figure below Put out the Hoisting rope from the drum of hoisting mechanism, cross the roller of counter jib, pulley of load limiter, then go back to the jib root pulley and get into the trolley and hook.

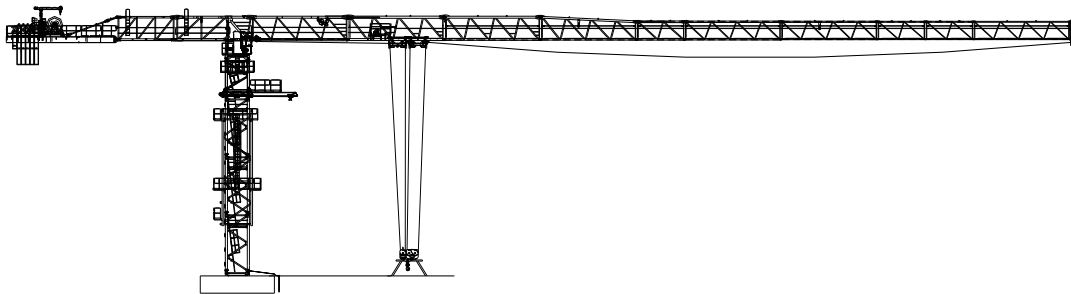


Fig. 4-47 Winding the hoisting rope (reference drawing)

- 2) Use two clips to fix the hoisting rope to the proper position on the trolley, leaving a margin of not less than 1.2m.
- 3) Remove the wedge from the anti-twist device of the jib tip, tie the end of the hoisting rope with soft rope, as shown in Fig. 4-48, and then make it rewind and secure with the fixing rope clamp.

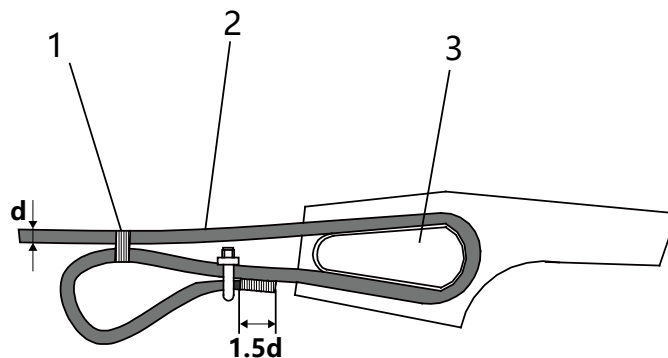


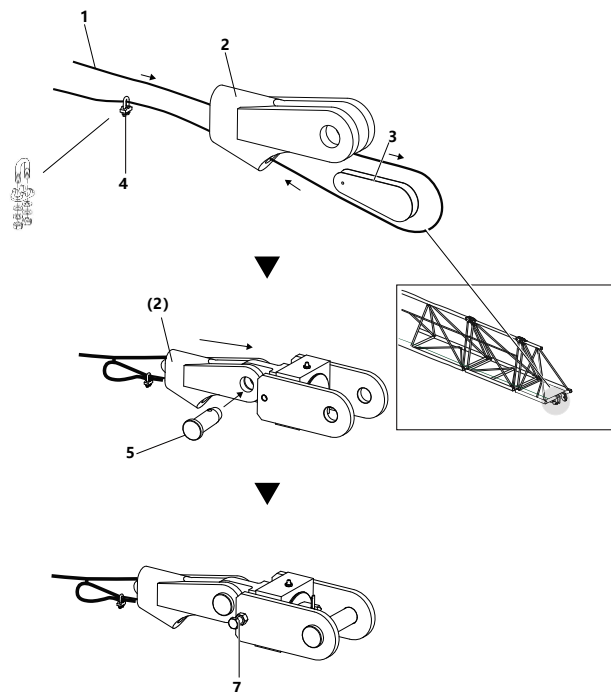
Fig. 4-48 The drawing of rope fixing

- | | |
|-----------|-------------------|
| (1) Wire | (2) Hoisting rope |
| (3) Wedge | |

- 1) Slowly start the hoisting mechanism. Hoist the hook to a height of **1m** above the ground, and make sure that the hoisting rope has been fixed firmly.
- 2) Start the trolley mechanism to open the trolley and hook to the hoisting tip jib.
- 3) Fix the wedge at the tip jib anti-twisting device. Slowly lower the trolley to the support below the tip jib. And dismantle the rope clamp that fixed the hoisting the trolley, and loosen the hoisting rope.



- When hoisting ropes are non-rotating ones, the anti-twist device shall lock tightly the locking screws 3 and 5 (see Fig. 4-49) while the tower crane is in service.
- When hoisting ropes are anti-rotation ones, the anti-twist device shall unlock the locking screws when the crane is in service.
- When using new ropes, the hook will rotate at no-load operation. At this time, unlock the anti-twist device.
- After long time using of tower crane, the wire ropes will be extended and slightly twisted, in this case, unlock the anti-twist device temporarily, and lock the device again when ropes have been tensioned.
- Once rope has their strands loosened, the anti-twist device will accelerate rope deterioration, so should change the deteriorated ropes timely.



- | | |
|-------------------|---------------------------------|
| (1) Hoisting rope | (2) Wedge |
| (3) Lock screws① | (4) Anti-twist device structure |
| (5) Lock screws② | |

Fig. 4-49 The drawing of rope fixing

4.17 Power line connection of mechanism

- Please refer to the attached circuit diagram for wire connection.
- The wiring diagrams are posted on prominent positions of mechanism, please refer to the diagrams for wire connection.

4.18 Electronic control system installation

- Please follow the attached circuit diagram to connect the circuit.

The wiring diagrams are posted on prominent positions of mechanism and electronic component (as Fig. 4-50), the two ends of cable also attached model name, connection position, parameters indicate (as Fig. 4-51). Please follow the instructions to connect wire.

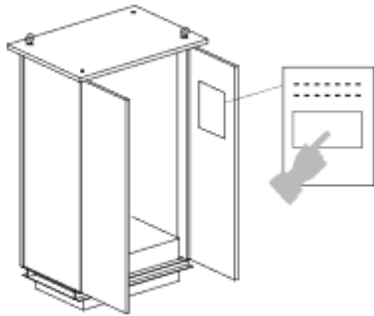


Fig. 4-50

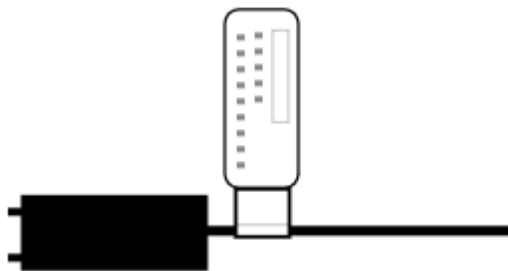


Fig. 4-51

- The installation of electronic control system need choose good weather condition (cannot raining/snowing/fogging). Otherwise, may damage electronic control system or personal injury.
- Before the installation of the electric control system, a preliminary inspection shall be carried out on all components of the electric control system to observe whether there is damage or loss of part in the control cabinet, and whether there is damage, carbonization and loosening of wires and cables. And please release the damaged equipment.
- Before the electric control system is not connected, separate insulation tests can be carried out on the motor, resistor, cable and other parts to judge whether there is a fault, but insulation test cannot be carried out after the connection of the electric control system.
- The wire connection and the body installation of all components in the control cabinet should be firm and reliable, and no loosening phenomenon should occur,
- The display screen of the auxiliary safety monitoring system should be fixed firmly and the communication cable connection should be reliable.
- Please connect the cables between the control cabinets as well as between the control cabinets and other external wiring diagram. please note that the connection of each cable should avoid interference with moving part, and also leave a margin for the moving part to move. If the cable slot, please put the cable in the slot.
- After wire connection, make sure circuit is correct, connection firm and reliable, no short circuit.



- *The cable hanging on the mast should using cable net, and set cable net every 20m.*
- *The power cable can only extension with intermediate junction box, directly junction is prohibited.*
- *The power cable and control cable should distribute separately, do not close parallel installation.*

4.18.1 Frequency converter self-learning

The tower crane is driven by full frequency conversion. When the crane is started for the first time, after trial operation and calibration setting, and before normal operation, the frequency converter of hoisting, slewing and trolley shall be studied and operated, so that the frequency converter can obtain the internal mechanism and make the operation more stable and efficient.

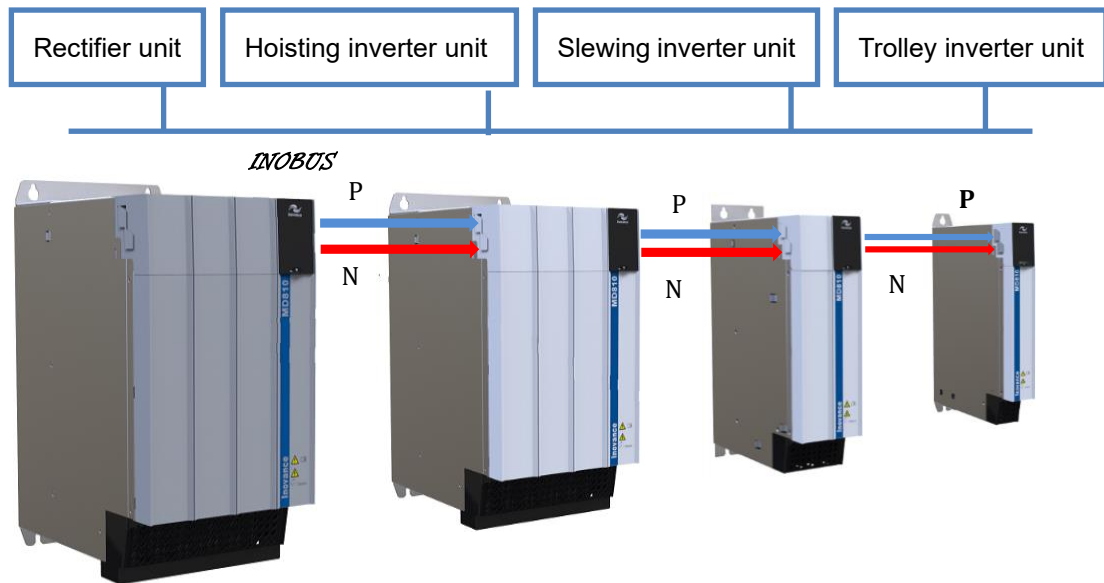


Fig. 4-52 Frequency converter structure

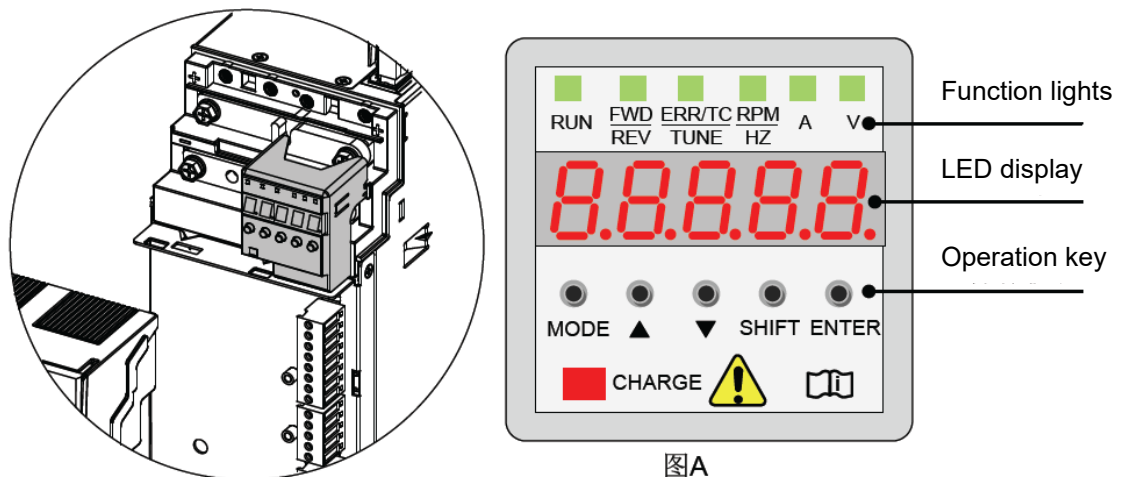


Fig. 4-53 Frequency converter operation panel

Key	Key's name	Key's function
 MODE	Mode key	Enter or quit the menu, switch the modes of inquiring parameters.
 ▲	Add key	Add the data or parameters.
 ▼	Reduce key	Reduce the data or parameters.
 SHIFT	Shift key	Choose the displaying parameters circularly, choose the spell of parameter to modify.
 ENTER	Enter key	Enter submenu, confirm set parameters.

■ Self-learning methods of frequency converter:

- 1) After the motor connected and powered on normally, first set the command source F0-02 of the frequency converter to 0 (command and control of the operation panel);
- 2) Input motor type plate parameters (A0.01-A0.05), when slewing self-learning change F4-00 to 0.
- 3) Set function code F1-37 to 3 (static tuning) and press "Enter" to confirm. At this time, the panel will display RUNE. Then press "Enter" on the panel and keep 3s, the frequency converter will drive the motor to start running. Waiting for 2 mins, the screen back to normal parameter display status, tuning done.
- 4) Set the frequency converter command source F0-02 to 2 (terminal control). when slewing self-learning change F4-00 to 8.

To further improve the performance of slewing mechanism, it is recommended to continue online tuning of the slewing frequency converter after the completion of static tuning. The steps are as follows:

- 5) Set the source B8-03 to 1 (online tuning), screen display "uLoc";
- 6) After confirming that there is enough room and safe operation, operate the slewing handle to the 4th gear. At this time, the tower crane jib will rotate the 4th gear speed. The frequency converter will successively display: ULoC→LoC→Good, which indicates that the spectrum tuning is over and normal use can be started.



*Note: ULoC: Start tuning online
LoC: Enter online tuning
Good: Online tuning ends*

If online self-learning fault, the frequency converter will display 'E77.00' code. need clear the fault and restart the self-learning process. Firstly, static tuning and make sure parameters are correct, then start online tuning. Before online tuning, drive the boom to the place which have enough moving distance, then start it. Change driving mode to level 3 or 4 and keep it. The screen display 'LOCK' means frequency locked, keep around 6 seconds, display 'GOOD', means tuning finished, we can shut down tower crane.

4.19 Power connection and test run

Switch on power to all electrical circuits according to the electric circuit diagram and start all mechanisms for test run. Check mechanism for proper operations. At the same time, check wire ropes at different locations for normal working and for any interference with structure member. Remove all abnormal cases.

4.20 Fall-changing system

4.20.1 Description

The fall-change system consists of 4 parts, i.e. the main trolley, the auxiliary trolley and main hook, auxiliary hook, the setting on the jib. Rope winding on the main trolley, the auxiliary trolley and main hook, auxiliary hook are as figure below. The connection-disconnection of the main trolley and the auxiliary trolley enable conversion of 2-fall and 4-fall (referred to hereinafter as fall-change).

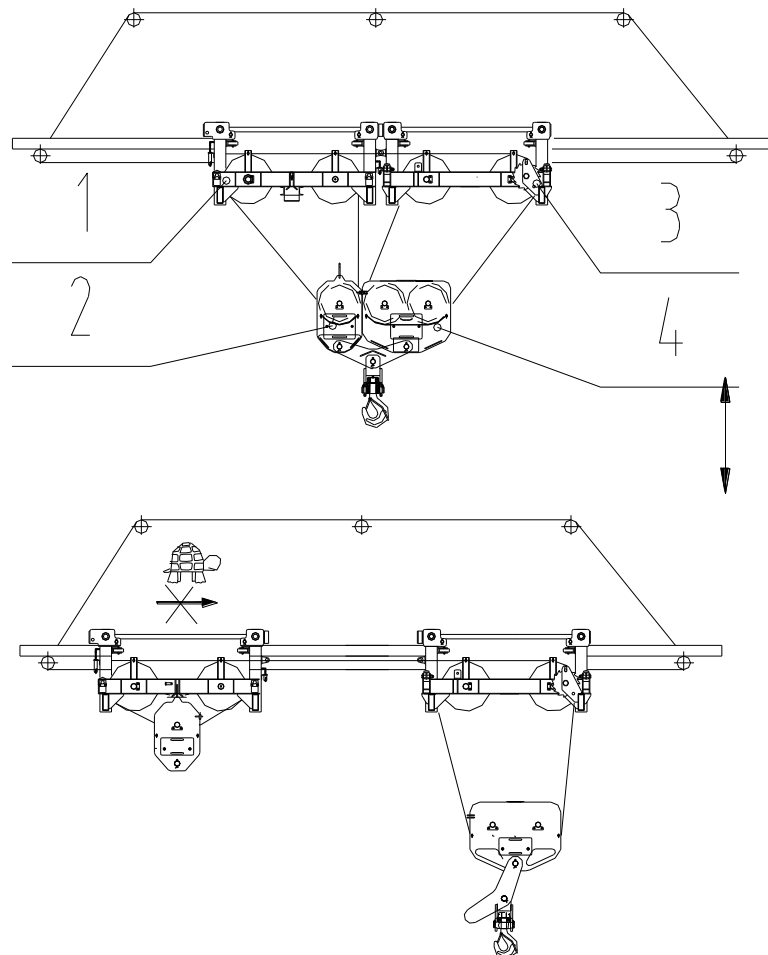


Fig. 4-54 The schema of the fall-changing system

(1) Auxiliary Trolley

(2) Auxiliary Hook

(3) Main Trolley

(4) Main Hook

The fall-change is converted at the jib root section under the conditions of no-load, slow speed and no swing. No matter how it is required to convert 2-fall to 4-fall or to convert 4-fall to 2-fall, the by-pass switch must at first be turned to the by-pass status to disable the height limiter. After conversion completion, the bypass switch must be restored to its original status. At the 2 fall working conditions, the auxiliary trolley is fixed at jib root, the auxiliary hook with automatic connection device contacts tightly the auxiliary trolley.

When main trolley and auxiliary trolley, main hook and auxiliary hook are connected together, main hook and auxiliary hook like two traveling pulleys, so the trolley work at 4-fall; When main trolley and auxiliary trolley, main hook and auxiliary hook are separated, auxiliary trolley is fixed at jib root connected auxiliary hook, auxiliary trolley and auxiliary hook like one immobile pulley, so the trolley work at 2-fall.

4.20.2 Method for 2-fall to 4-fall conversion

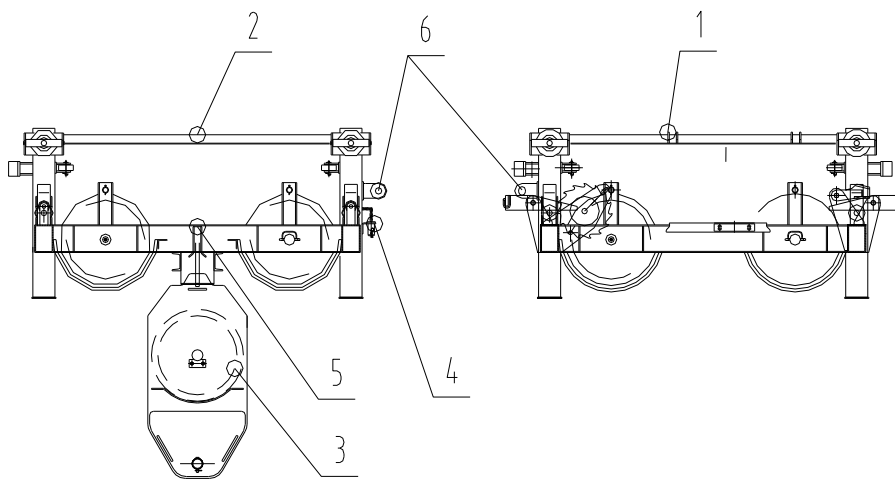


Fig. 4-55 2-fall to 4-fall conversion

- | | |
|-----------------------|-----------------------|
| (1) Main Trolley | (2) Auxiliary Trolley |
| (3) Auxiliary Hook | (4) Pin A |
| (5) Pin B | (6) Pin C |
| (7) Connecting base A | (8) Connecting base B |

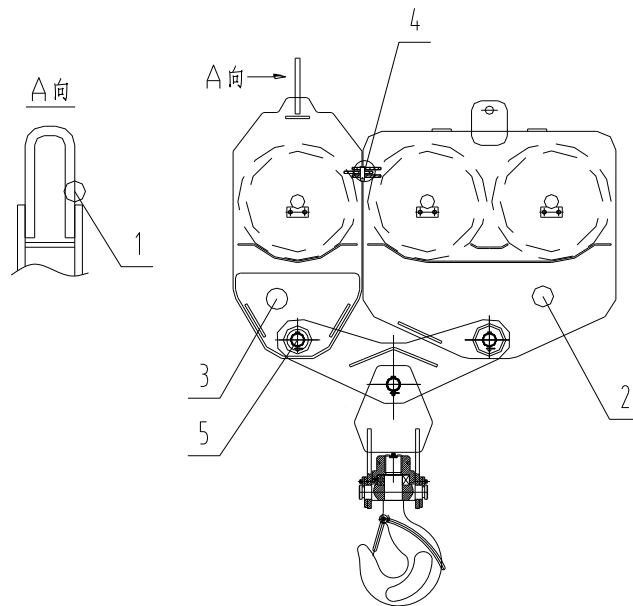


Fig. 4-56 Hook

- | | |
|--------------------|---------------|
| (1) Plate | (2) Main hook |
| (3) Auxiliary Hook | (4) Pin A |
| (5) Pin B | |

- 1) Before fall-change, auxiliary hook is fixed at auxiliary trolley by shafts b, auxiliary trolley is fixed at jib root by shafts a, and then auxiliary trolley is stopped (Fig. 4-55).
- 2) Operate slowly the trolley to move back, when the main trolley impacts the auxiliary trolley. Connect the main trolley and auxiliary trolley with shafts c. Pull back the hoisting rope, uninstalling the shafts b, disport the auxiliary hook and auxiliary trolley; uninstalling the shafts a, disport the jib and trolley (Fig. 4-55).
- 3) Operate the hoisting mechanism, place down main hook and auxiliary hook on the ground, insert pin a and pin b, connect main hook and auxiliary hook together (Fig. 4-56), then realize the conversion 2-fall to 4-fall.

4.20.3 Method for 4-fall to 2-fall conversion

- 1) Lower the hook to the ground, dismantle the pin 1 pin 2, separate the auxiliary hook and main hook.
- 2) Start the hoisting mechanism slowly, raise the auxiliary hook, at the same time, and operate the trolley to the jib root. Raise the auxiliary hook continuously, when contact the auxiliary trolley, stop hoisting, then insert shaft a and shaft b, dismantle the shaft c.
- 3) Drive the trolley mechanism, and let the main trolley to slowly move out. Then realize the conversion 4-fall to 2-fall.



Please adjust the safety device before starting to use the tower crane.

4.21 Assembling the chassis and placing the central ballasts

For the stationary / travelling chassis tower crane. It needs to assemble the chassis and place central ballasts on the chassis.

4.21.1 Description

The chassis can be used for stationary chassis tower crane or travelling chassis tower crane. It mainly consists of 2 piece beams, 2 straight struts, an incline strut, 4 struts, and 2 different base tower sections for chassis. As shown in Fig. 4-57 or refer to **Section 7.19** for details.

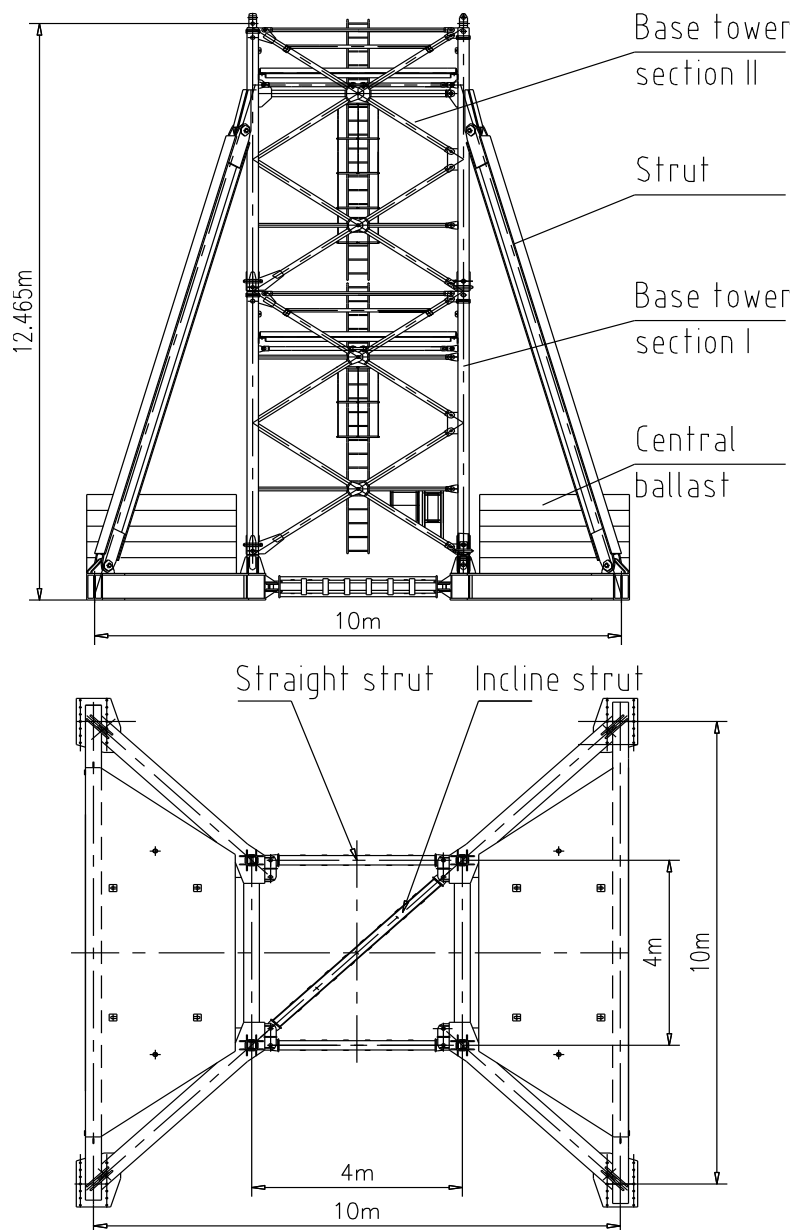


Fig. 4-57 Chassis and central ballasts

4.21.2 Processes

- 1) Connect the 2 piece beams together by the straight struts and the incline strut, refer to Fig. 4-58 and

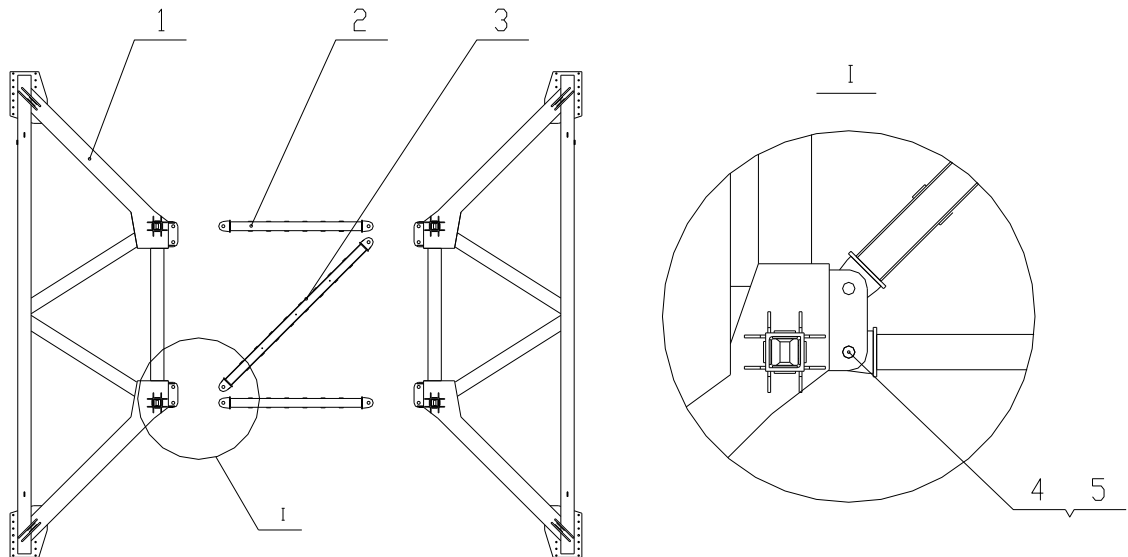


Fig. 4-58 Connecting the 2 piece beams

Table 4-31 Parts for connecting the 2 piece beams

No.	Designation	Specification	Qty
1	Piece beam		2
2	Straight strut		2
3	Incline strut		1
4	Pin	$\Phi 70 \times 375$	6
5	Split pin	13×125	6

- 2) Assemble the base tower section I and II according to **Section 3.8.2.1**. Lift and the base tower section I to the assembled piece beams, connect them by **8** pins of **Φ75**. Knock the pins until their shoulders fit the surfaces of main chords, then insert the split pins and spring pins. Then install the base tower section II onto the base tower section I. Refer to Fig. 4-59 and Table 4-32.

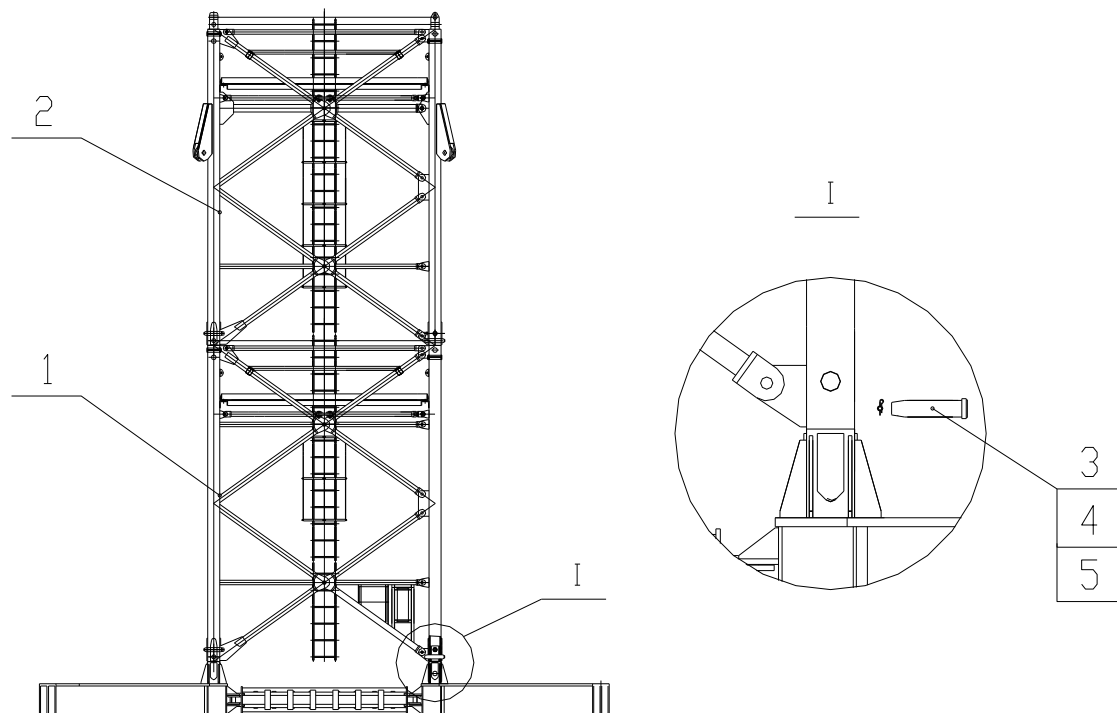


Fig. 4-59 Installing the base tower sections

Table 4-32 Parts for installing the base tower sections

No.	Designation	Specification	Qty
1	Base tower section I		1
2	Base tower section II		1
3	Pin	Φ75×281/360	16
4	Lock pin		16
5	Split pin	Φ5	32

- 3) Connect one end of the strut with the base tower section II and connect the other end with the piece beam by pins of $\Phi 100$. Refer to Fig. 4-60 and Table 4-33.

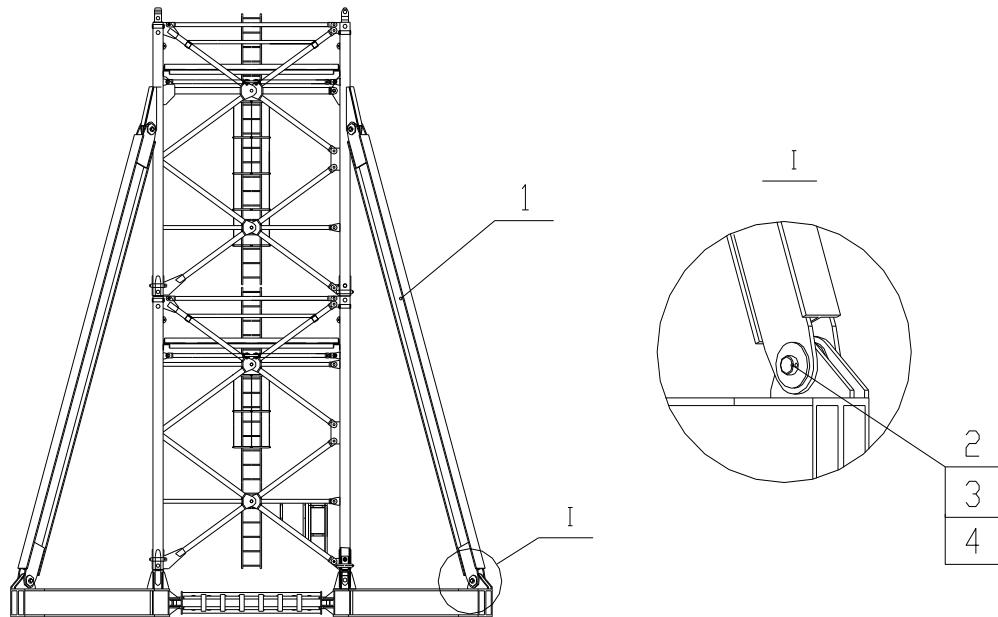


Fig. 4-60 Installing the struts

Table 4-33 Parts for installing the struts

No.	Designation	Specification	Qty
1	Strut		4
2	Pin C	$\Phi 100 \times 315/405$	8
3	Lock pin	$\Phi 20 \times 112/129$	16
4	Split pin	6.3×40	32

- 4) Place the central ballasts onto the assembled chassis, refer to **Section 3.7** for the quantities.

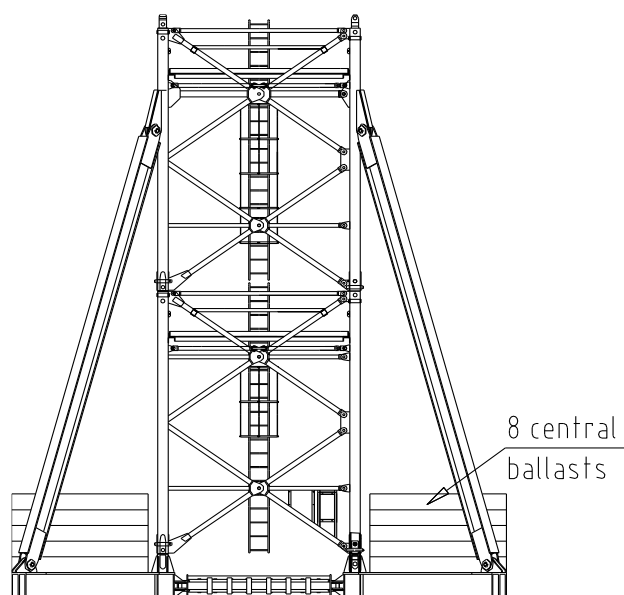


Fig. 4-61 Placing the central ballasts

4.22 Safety devices

4.22.1 Foreword

The safety devices of tower crane include: moment cutouts, load limiters, traveling limiter (include hoisting limiter, trolley limiter, slewing limiter) and weathervane.

The safety device of this tower crane, besides the above mechanical limiter, also has electronic safety device in the auxiliary safety monitor system. The installation position of the safety devices shows in Fig 7-69 and table 7-26.



The crane over 30 and higher than surroundings, need installed red obstruction light on tower head and front/rear jib end, this light power not affected by crane shutdown. If crane higher than 50m, need install weathervane.

The safety devices introduce in this chapter are mechanical limiter. Before calibration, turn mode choice switch (SPM) to 'mechanical', then begin calibration. After calibration, turn SPM to 'electronic'.



- **Safety devices should be the important inspection device of driver and maintenance personal.**
- **Safety device of tower crane are designed for protecting human and equipment safety, after calibration, shouldn't change it.**



- *Using the equipment before safety device installation or calibration is prohibited, otherwise will lead to equipment damage and personnel injury even death.*
- *Only use electronic limiter without mechanical limiter calibration is prohibited.*

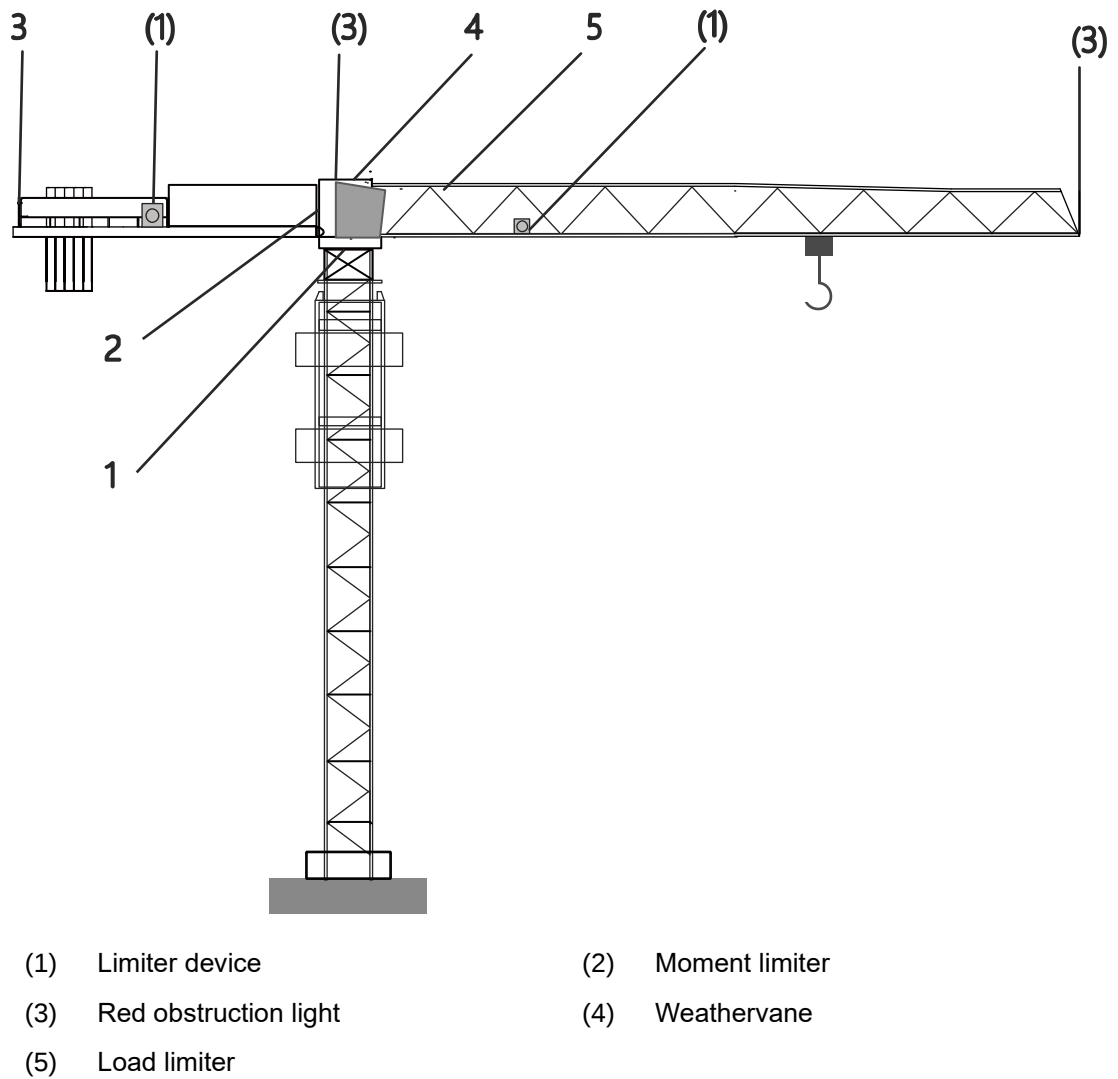
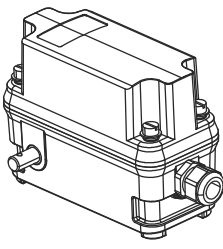
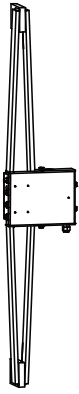
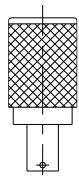
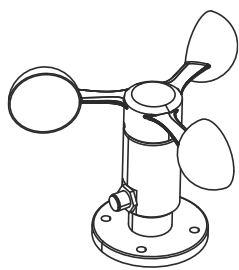
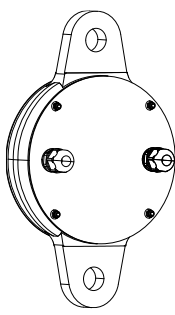


Fig. 4-62 Safety device location

Table 4-34 Safety device combination

No	Shape	Name	Location	Qty
1		Hoisting limiter	Hoisting mechanism	1
		Trolley limiter	Trolley mechanism	1
		Slewing limiter	Turntable	1
2		Moment limiter	Tower head	1
3		Red obstruction light	Counter jib, tower head, jib end	2
4		Weathervane	Tower head	1
5		Load limiter	Jib I	1

4.22.2 Overload protection device

4.22.2.1 Load moment limiter

■ Function

The design of the tower crane is based on a certain maximum load moment. It is strictly forbidden to exceed this maximum load moment when the tower crane is working.

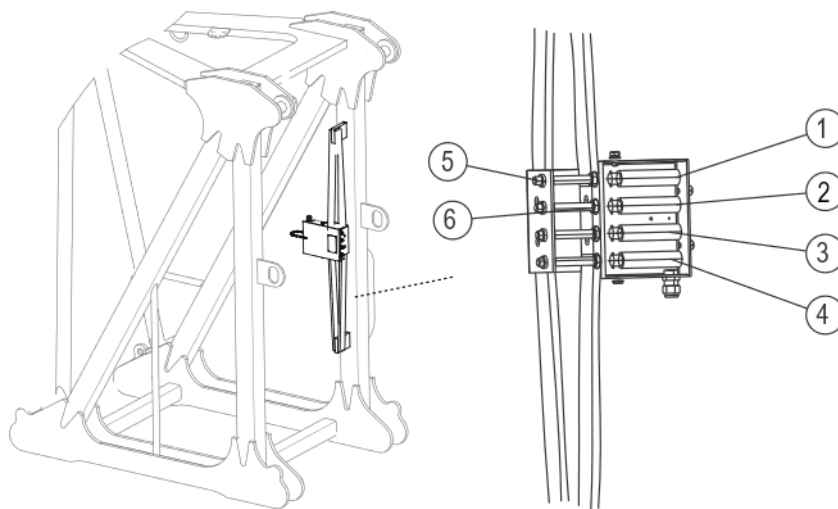
The function of the load moment limiter is to prevent the working moment of the tower crane from exceeding the rated maximum lifting moment.

■ The working principle of load moment limiter

The load moment limiter is composed of a bow-shaped plate that magnifies the deformation and several limit switches (Fig. 4-63). There are several adjustable bolts on the plate. The bolts correspond to the travel switch. Under the action of the load torque, the adjustable bolt (6) Contact with the travel switch (1-4) to output overload deformation signal to remind the operator or make the operator's operation invalid.



According to the clearance between adjustable bolt and limit switch, the switch acts within the safety control circuits subjected to load moment.



- (1) Travel switch SMA2
- (3) Travel switch SML2
- (5) Anti-loosen nut

- (2) Travel switch SMA1
- (4) Travel switch SML1
- (6) Adjustable bolt

Fig. 4-63 Load moment limiter



- The adjustment of the load moment limiter should be carried out at the independent height! The independent height is marked in "Technical Parameters of Tower Crane". When the adjustment is made beyond the independent height or the large height, the weight of the lifting weight should be subtracted from the weight of the wire rope exceeding the height and the additional weight of the hook.
- After adjustment, lock the locknut.

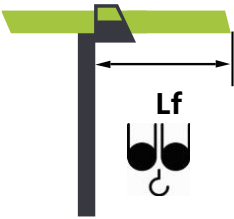
■ Adjustment method

Adjust the individual switches of the load moment limiter shown in the diagram above (Fig. 4-63) according to the parameters in the table below. The specific adjustment method is shown in the back of the table.

Table 4-35 Adjustment parameters(2-fall)

	Lf/m	X/kg	Y/kg	W/t	Ld/m	Lw/m	L/m	L'/m
	80	15.6	17.2	32	34.8	39.2	43.5	47.9
	75	17.2	18.9	32	35.4	39.8	44.2	48.6
	70	18.9	20.8	32	35.7	40.1	44.6	49.1
	65	20.9	23.0	32	36.0	40.5	45.0	49.5
	60	23.2	25.5	32	36.3	40.9	45.4	49.9
	55	25.9	28.5	32	36.6	41.1	45.7	50.3
	50	28.9	31.8	32	36.6	41.1	45.7	50.3
	45	/	/	/	/	/	/	/
	40	/	/	/	/	/	/	/
	35	/	/	/	/	/	/	/
	30	/	/	/	/	/	/	/

Table 4-36 Adjustment parameters(4-fall)

	Lf/m	X/kg	Y/kg	W/t	Ld/m	Lw/m	L/m	L'/m
	80	13.2	14.5	64	18.2	20.4	22.7	25.0
	75	14.8	16.2	64	18.4	20.7	23.0	25.3
	70	16.5	18.1	64	18.6	20.9	23.2	25.5
	65	18.5	20.3	64	18.7	21.1	23.4	25.7
	60	20.8	22.8	64	18.9	21.2	23.6	26.0
	55	23.5	25.8	64	19.0	21.4	23.8	26.2
	50	26.5	29.1	64	19.0	21.4	23.8	26.2
	45	30.1	33.1	64	19.0	21.4	23.8	26.2
	40	34.8	38.3	64	19.0	21.4	23.8	26.2
	35	40.8	44.9	64	19.0	21.4	23.8	26.2
	30	49.0	53.9	64	19.0	21.4	23.8	26.2

**Lf:** Jib length**X:** Rated weight on jib end**Y:** 110% rated weight on jib end**W:** Maximum rated weight**Ld:** 80% of **L****Lw:** 90% of **L****L:** Maximum trolley distance of **W****L':** 110% of **L**

■ Load moment deceleration

Lift the maximum rated lifting weight W at a small amplitude to 1m above the ground, and trolley outward at a normal speed. When L_d is reached, adjust the load limiter bolt so that SMA2 (1) is triggered, and the trolley outward automatically switch to low speed.

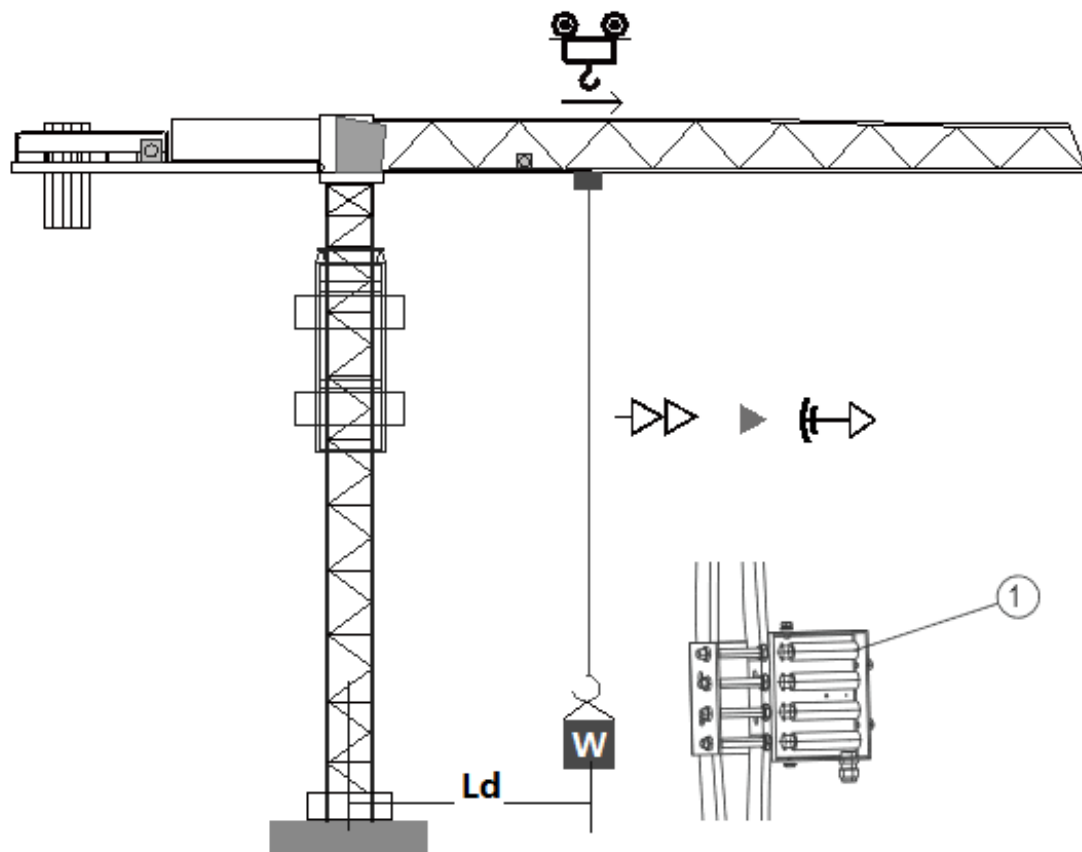


Fig. 4-64 Adjustment of trolley moment limiter

■ Load moment early warning

If the trolley continue to outward at a low speed and reaches L_w , the adjusting load moment limiter SMA1 is triggered, 90% moment yellow lights up and alarm.

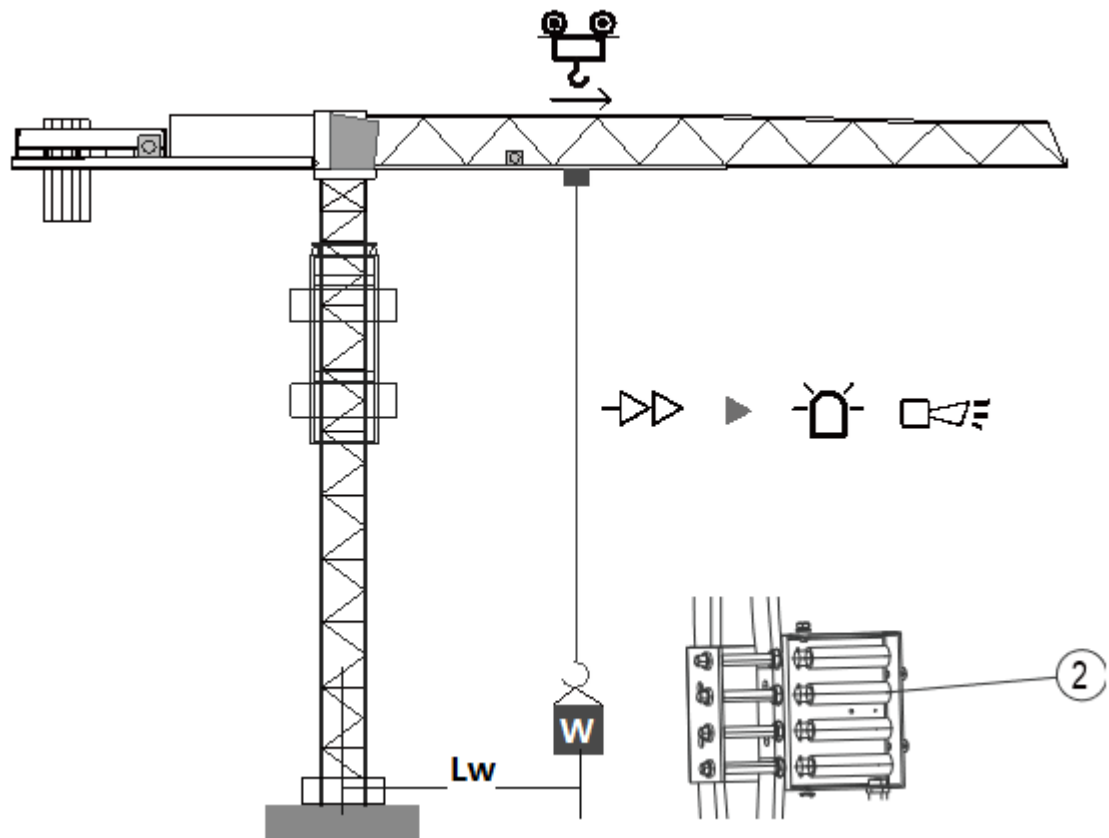


Fig. 4-65 Adjustment of moment limiter early warning

■ Constant load for variable radius

When the trolley reach to the position of $L \sim L'$, adjust the moment limiter to trigger the SML2(3), then the “100% moment” light is on, and there is warning sound, the trolley out and hoisting up movements are limited.

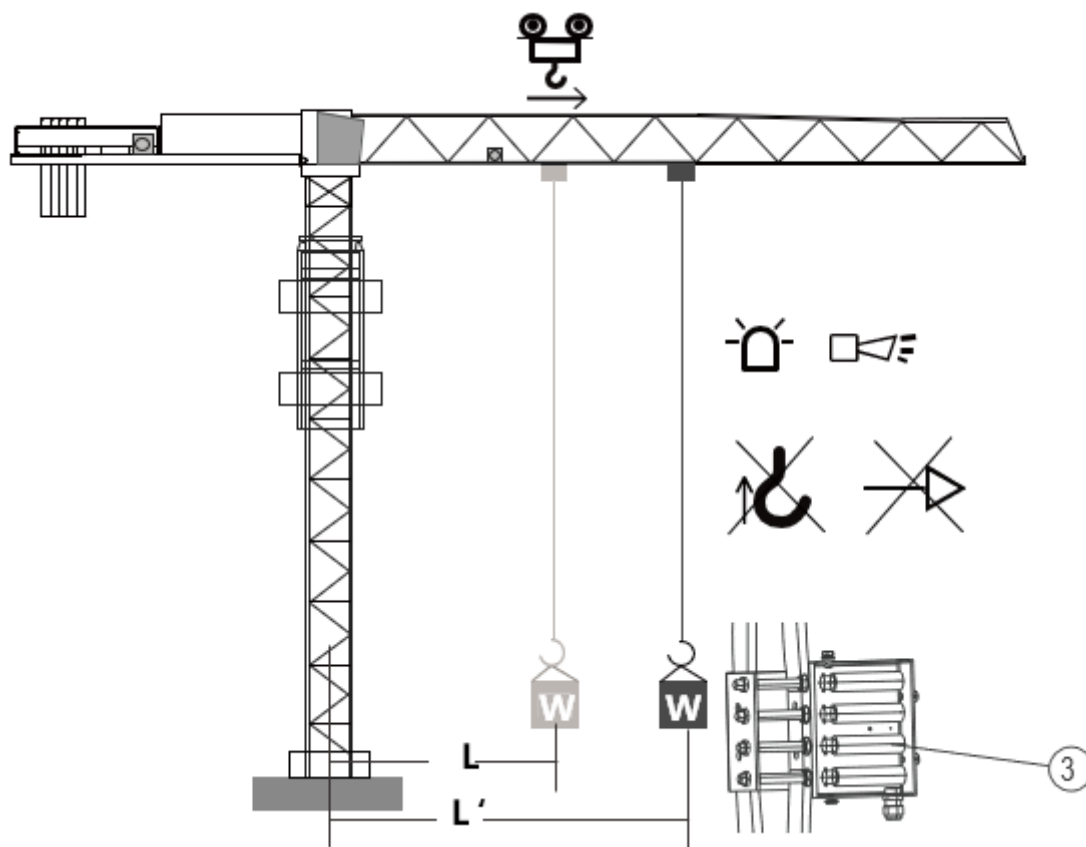


Fig. 4-66 Adjustment of constant load for variable radius

■ Constant radius for variable load

The normal permit maximum load at the jib end is X, without any moment limiter being triggered, the hoisting is normal. When the load to Y, the adjusting moment limiter SML1(4) is triggered. At this time, the hoisting up power is cut off, the 100% moment red lights up and alarm, the hoisting up is restricted.

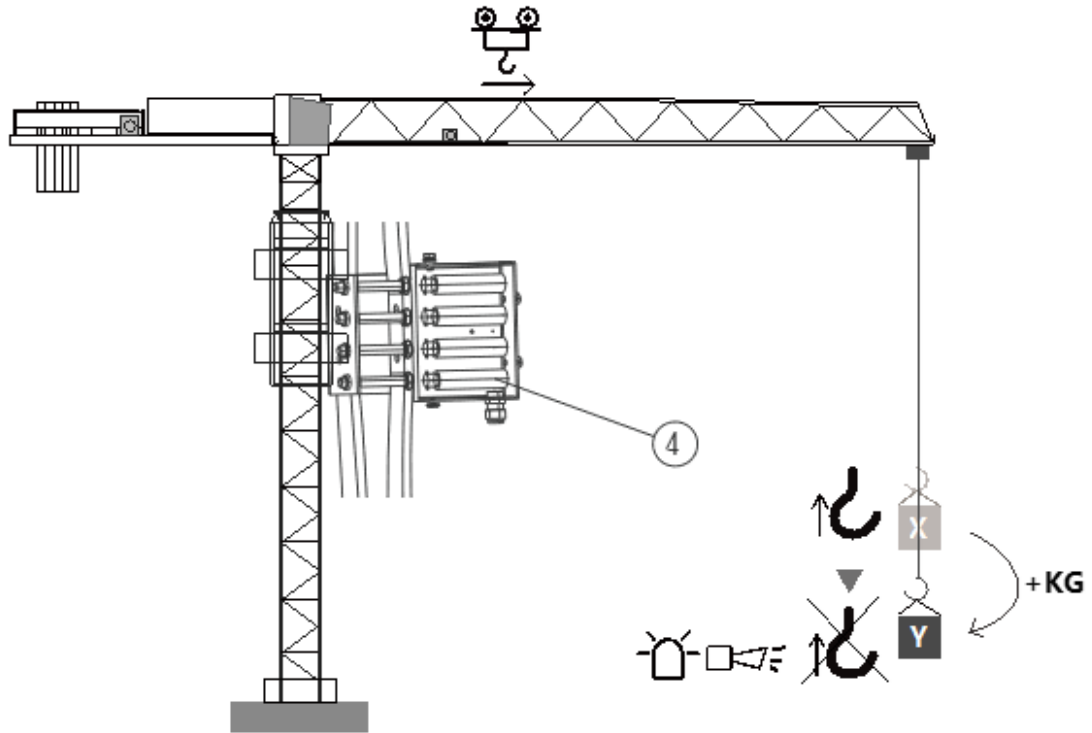


Fig. 4-67 Adjustment of constant radius for variable load

■ Seal

After adjusting and checking moment limiter, close the rain cover of moment limiter, and then wear it with steel wire through the hole of the rain cover and add lead seal.

4.22.2.2 Load limiter

■ Function

It is prohibited to exceed the maximum load capacity of tower crane during operation. Load limit switches are used to prevent the tower crane from exceeding the maximum load capacity.

■ Working principle

The load moment limit switch is a dynamometric ring consisting of metal strips, adjustable screws, several limits switch etc. Each screw corresponds to one limit switch. During HOIST operation, certain force running over the hoisting rope is applied to the dynamometric ring, and will cause the metal strips to deflect. This deflection of metal strips allows the adjustable screws to contact and act on the limit switch, which would alert the crane operator in case of any overload situation via acoustic and optical signals.

This system allows the contactors to act on the safety circuit depending on the loads to be controlled, when appropriately adjusting the gap between adjustable screw and limit switch.



- This system allows the contactors to act on the safety circuit depending on the loads to be controlled, when appropriately adjusting the gap between adjustable screw and limit switch.
- The load limit switch has been pre-calibrated at the factory and needs to be checked on site. If the deviation is too large, please adjust it according to the following adjustment steps.

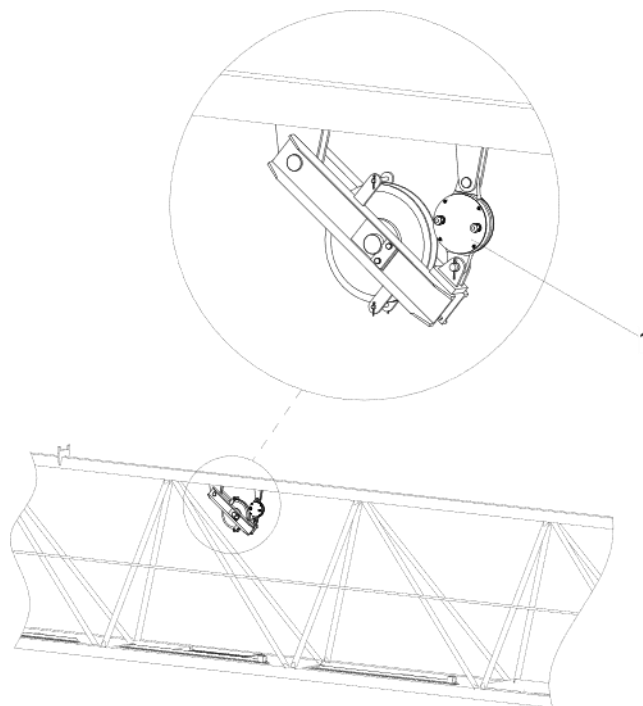


Fig. 4-68 Load limiter

■ Installation and using of the load limiter

Fix the load limiter to the position of the jib (jib I or II) by the hole (4) and a pin. The cover can be opened by screw out the nut (1). You can use the adjust wrench (3) on the cover back to adjust the adjusting switch inside. Connect the lines through the hole (2).

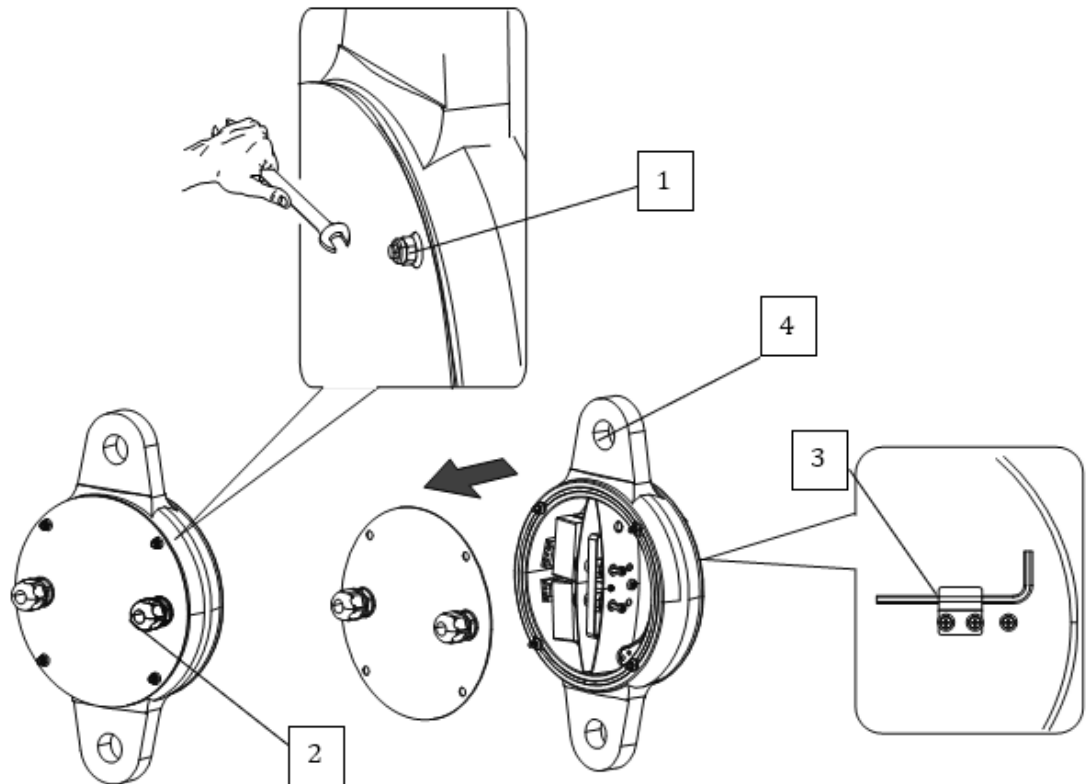


Fig. 4-69 Installation of load limiter



The figure above is for instruction only, it doesn't refer to the limiter of your crane in particular, but you can take it as a reference.

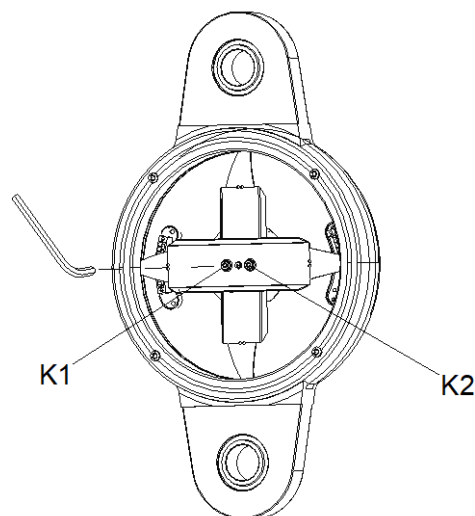


Fig. 4-70 Switch of load limiter

■ Adjusting for High-speed hoisting

Hoisting load A at the minimum radius, the hoist speed can be reach at high speed, add 10% weight, and then adjust load limit switch K2 is triggered. At this time, the high-speed hoisting radius is restricted, "50% rated load" yellow lights up, the height of hoisting is restricted at low speed.

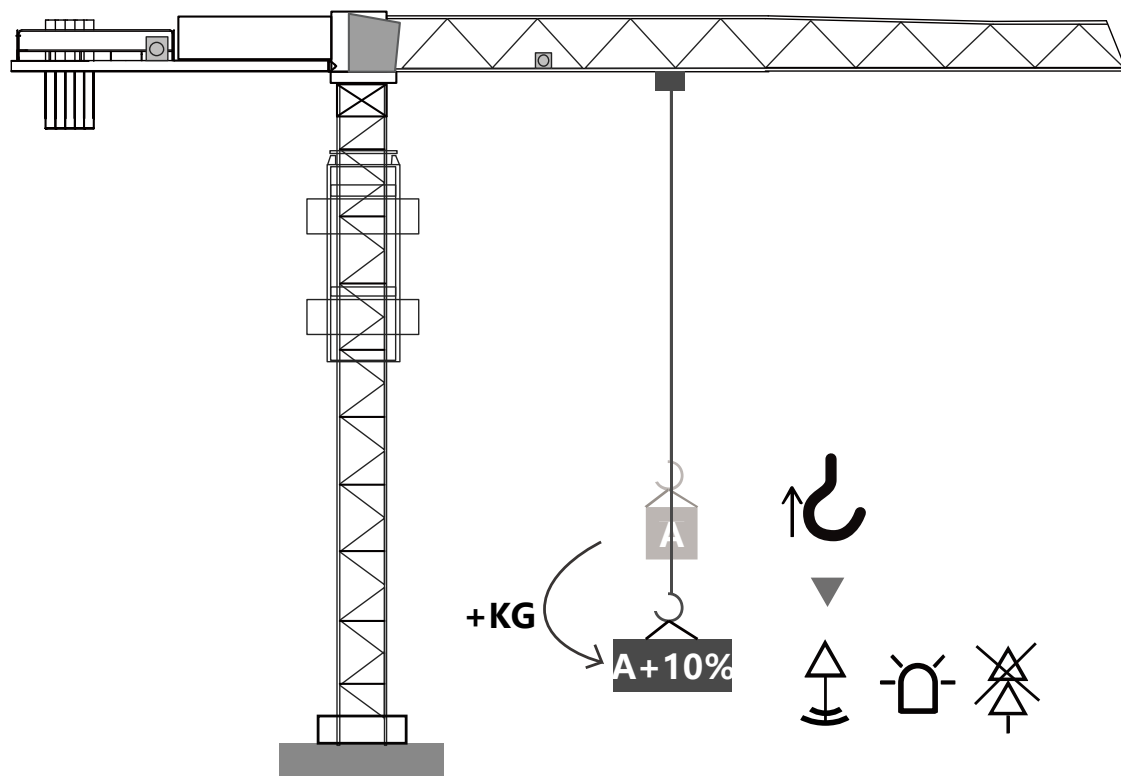


Fig. 4-71 High-speed hoisting for 50% rated load

■ Adjusting for maximum hoisting load

Hoisting load B at the minimum radius, the hoist speed can be reach at low speed, add 10% weight, and then adjust load limit switch K1 is triggered. At this time, "100% load" red lights up and alarm, the upward hoist actions are restricted.

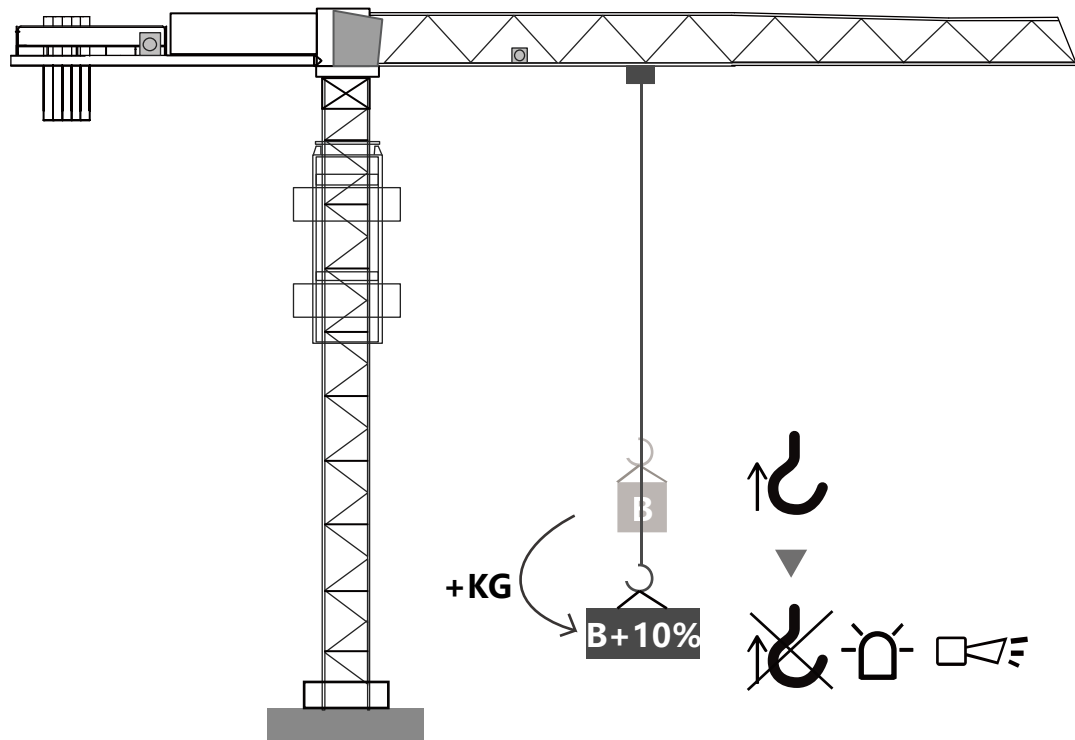


Fig. 4-72 Adjusting for maximum hoisting load

■ Adjust parameter table of load limit switch

Table 4-37 Adjust parameter table of load limit switch

Fall	A (kg)	A+10% (kg)	B (kg)	B+10% (kg)
	16000	17600	32000	35200
	32000	35200	64000	70400

■ Seal

After adjusting and checking load limit switch, close the rain cover, and tightening the bolts, and then wear it with steel wire and add lead seal.

4.22.3 Limiters

The limiters of tower crane include: hoisting limiter, Trolley limiter, slewing limiter, they are important safety devices to accomplish the traveling control and position limit of each mechanism. Hoisting mechanism, trolley mechanism, slewing mechanism equipped electronic sensors, these sensors will monitor mechanism position and control system will convert the position signal to electronic limiter.

This crane can implement electronic limiter and mechanical limiter control, the solely mechanical limiter only used for emergency and need adjust to meet the regulation.



- After change the rope or falls, the extreme position of hook will change, need readjust the hoisting limiter. Otherwise, may cause hook impact jib, rope break, and lead to fatal accident.
- When hook at the lowest position, need keep at least 3 circle rope on the drum.



- When crane climbing to the expectation height, adjust must without load and make sure micromove switch is correct.
- When change tower crane height and falls, adjusting hoisting limiter.
- Screw in M5 nut after adjust travelling limiter, otherwise cause memory mess.
- Recovery the shell after adjusts the travelling limiter, otherwise the limiter may damage by water.

4.22.3.1 Functions of limiter

Hoisting limiter make hook decelerate and stop hoisting when come to the safety distance from trolley to the hook, when downward, prevent the wire rope from loosening completely and wrapping around the drum in the opposite direction.

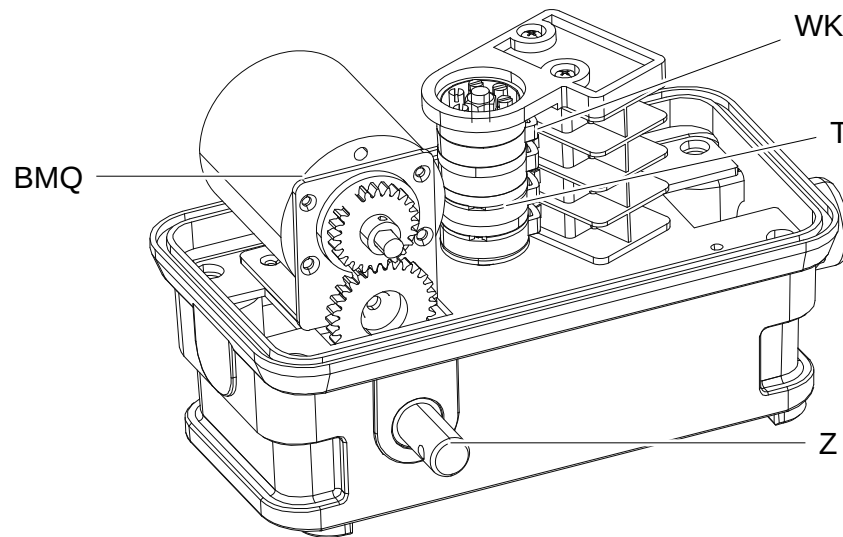
The Trolley limiter enables the trolley to automatically decelerate and stop before reaching the stop block at the root or head of the boom.

The slewing limiter is used for tower cranes without slip ring to prevent the cables from being entangled and damaged, allowing a maximum rotation of 3 turns.

- The working principle of the limiter

The limit device fixed on the bracket can be directly driven by the wind shaft, or driven by the pinion gear meshing on the toothed ring. There is a deceleration mechanism in the device, which drives several bumps to rotate (T), and these bumps control several circuit breakers (WK micro switch) action, thereby cutting off the corresponding mechanism movement.

In addition to the mechanical limit switch, the limiter is also equipped with an encoder (non-ETI version has no encoder). As shown below.



BMQ: Encoder

WK: Micro switch

T: Memory cam

SRZ: Input shaft

Fig. 4-73 Limiter

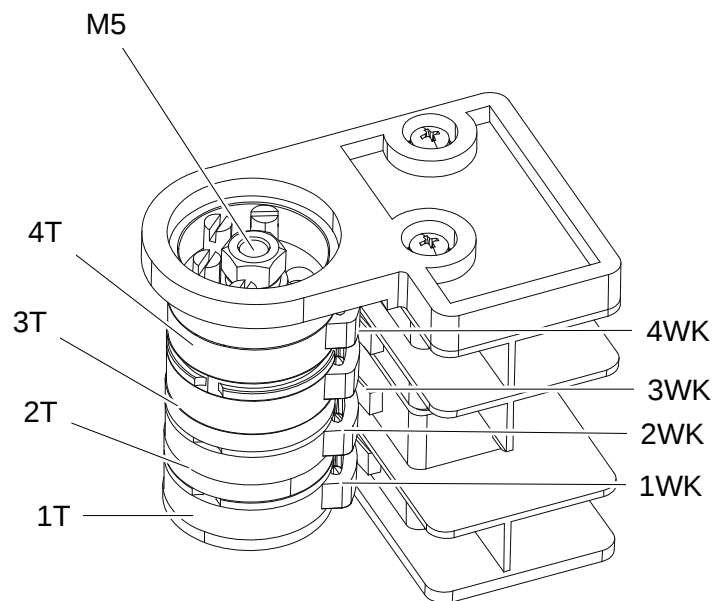
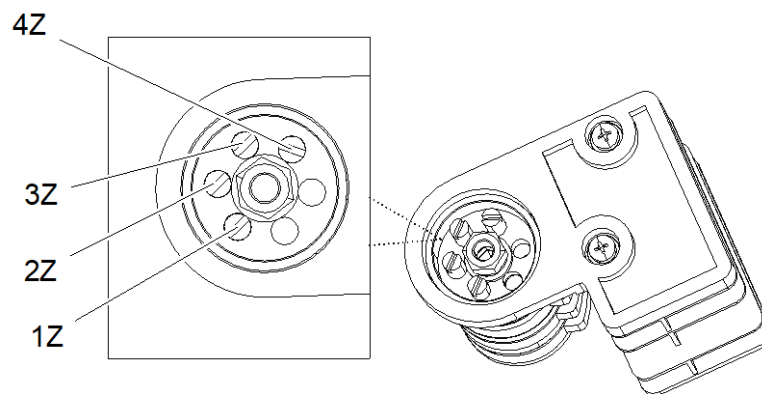


Fig. 4-74 Inside of the limiter

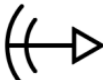
Adjust the shaft (1-4 Z), cam (1-4 T) and micro switch (1-4 WK), the corresponding relationship is as follows:

1Z	→	1T	→	1WK
2Z	→	2T	→	2WK
3Z	→	3T	→	3WK
4Z	→	4T	→	4WK

■ Traveling limiter adjustment steps:

- 1) Remove the upper cover and loosen the M5 nut.
- 2) According to the need, open the controlled mechanism to the designated position (no-load), at this time, the corresponding micro switch is switched instantaneously when controlling the action of the mechanism. That is, adjust the corresponding adjustment axis (Z) so that the memory cam (T) presses the contact of the micro switch (WK).
- 3) Tighten the M5 nut (the nut must be tightened to prevent loosen).
- 4) The mechanism repeatedly runs with no load for several times to verify whether the memory position is accurate (repeat the above adjustment if there is an error).
- 5) Confirm that the position meets the requirements and install the cover.
- 6) After the mechanism is working normally, it should always be checked whether the memory control position has changed so as to be corrected in time.

Table 4-38 The meaning of the indication signs

Symbol	Meaning
	Low speed operation
	Middle speed operation
	High speed operation
	Deceleration/ speed limited
	Load

Symbol	Meaning
	Slewing
	Hoisting hook
	Observation
	Sound alarming
	Light alarming
	Trolleying

4.22.3.2 Hoisting limiter

■ Hoisting up deceleration

When the distance between the hook pulley and the trolley is H1, mobilize the (3Z) axis to make the long cam (3T) press the micro switch (3WK), so that the hook rises at a low speed.

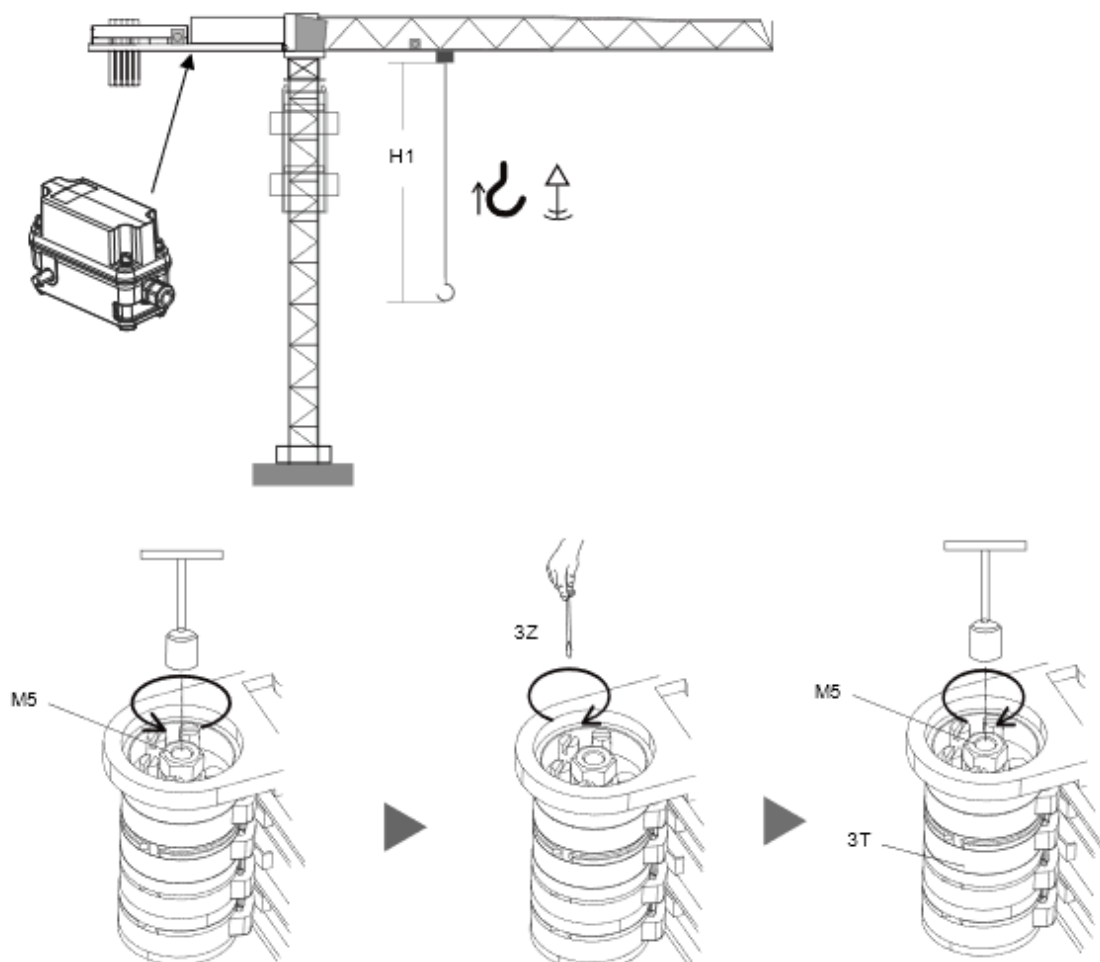


Fig. 4-75 Hoisting up deceleration

■ Hoisting up stop

When the distance between the trolley and the hook pulley is H2, the (4Z) axis is mobilized to make the long cam (4T) press the micro switch (4WK), so that the hook cannot continue to move upward.

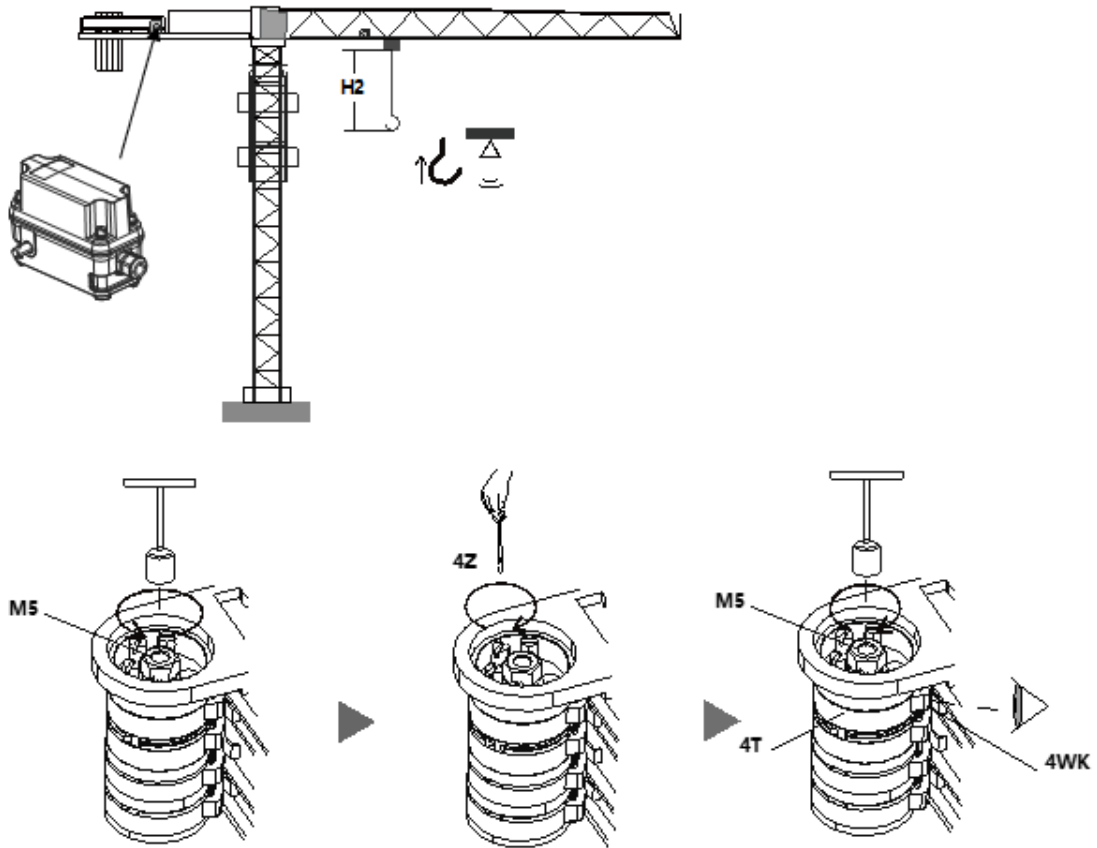


Fig. 4-76 Hoisting up stop



The down hoisting stop principle just same as up hoisting, adjust the switch position.

■ Hoisting down stop

Move the (2Z) axis to make the long cam (2T) press down the micro switch (2WK), so that the hook can stop before it touches the ground (the hook cannot touch the ground to prevent the wire rope from loosening on the wind).

■ Hoisting down deceleration

Move the (1Z) axis to make the long cam (1T) press down the micro switch (1WK), so that the hook can descend at a low speed at H2 before the lower limit position.

4.22.3.3 Trolley limiter

■ Trolleying outward deceleration

The trolley is driven to L1 from the boom tip buffer, and the (3Z) axis is mobilized, so that the long cam (3T) presses the micro switch (3WK), so that the trolley can only run outwards at a low speed.

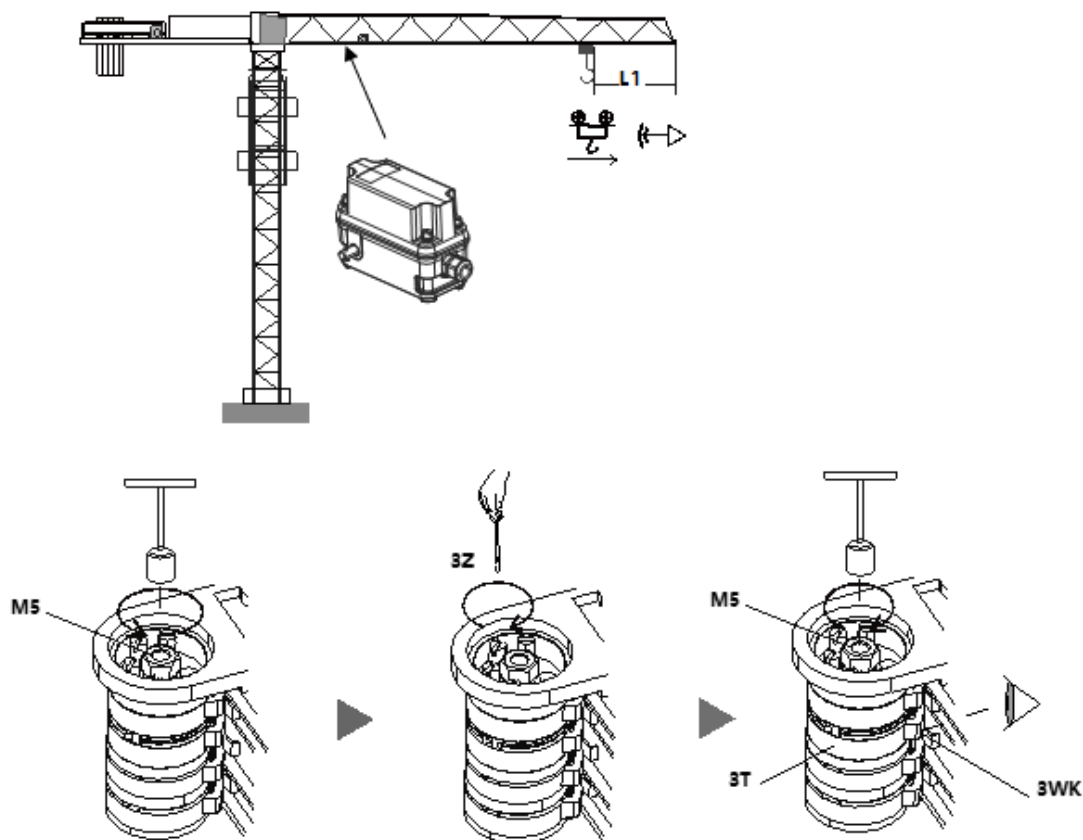


Fig. 4-77 Trolleying outward deceleration

■ Trolleying outward stop

The trolley is driven to L2 from the boom tip buffer, and the (4Z) axis is mobilized, so that the long cam (4T) presses the micro switch (4WK), so that the trolley cannot continue to run outwards.

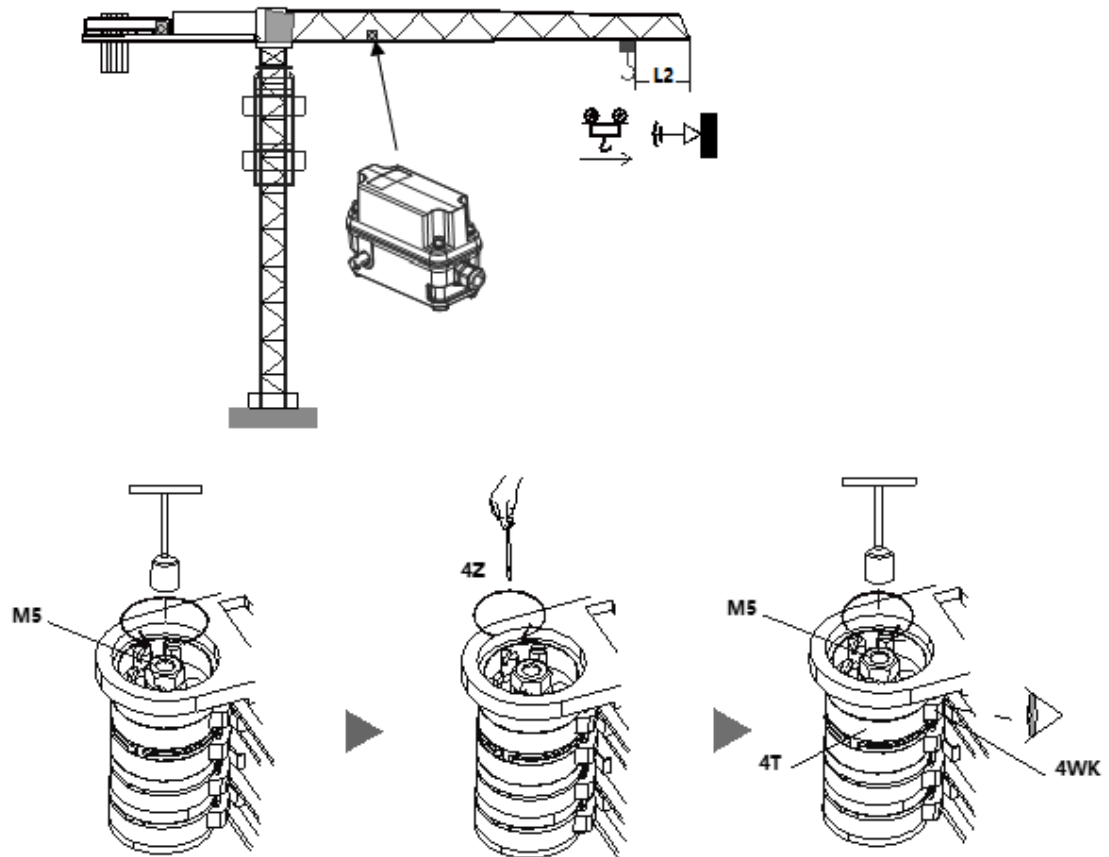


Fig. 4-78 Trolleying outward stop

■ Trolleying inward deceleration

Drive the trolley to L1 from the boom root buffer, mobilize the (1Z) axis, so that the long cam (1T) presses the micro switch (1WK), so that the trolley can only run inward at a low speed.

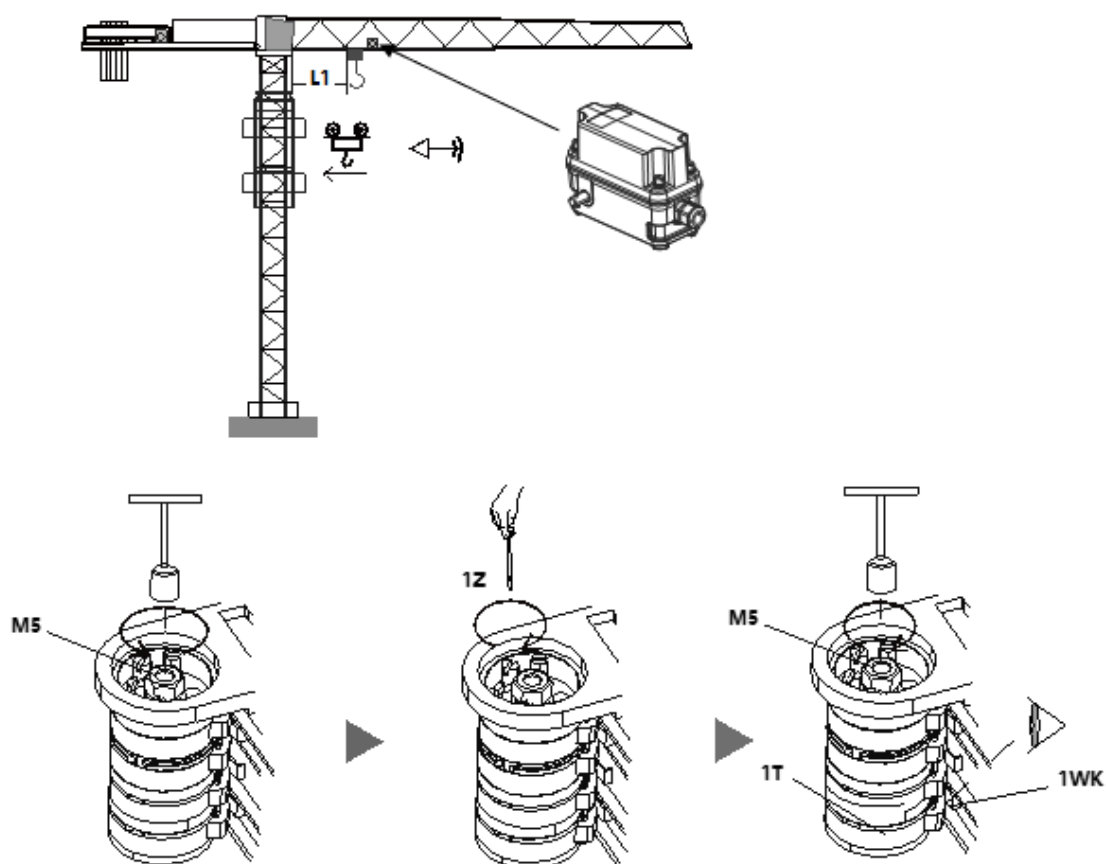


Fig. 4-79 Trolleying inward deceleration

■ Trolleying inward stop

The load trolley is luffed to L2 meters away from the boom root buffer, and the (2Z) axis is mobilized, so that the long cam (2T) presses the micro switch (2WK), so that the trolley cannot continue to run inward.

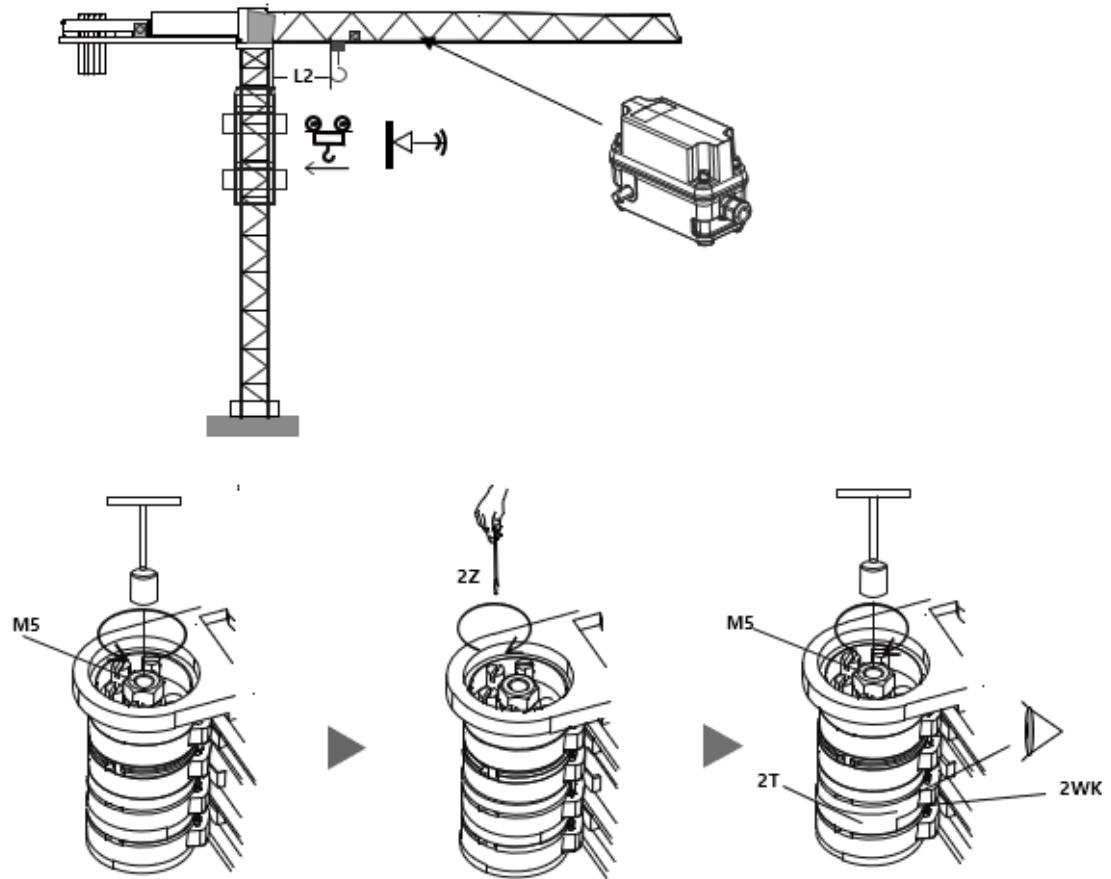


Fig. 4-80 Trolleying inward stop

4.22.3.4 Slewing limiter

■ Slewing leftward stop

Adjust the slewing limiter when the cable is in a free state; rotate RA1 counterclockwise to 540° (1.5 circles), mobilize the adjustment shaft (4Z) to make the long cam (4T) move until the micro switch (4WK) is switched instantaneously, and then tighten the M5 nut.

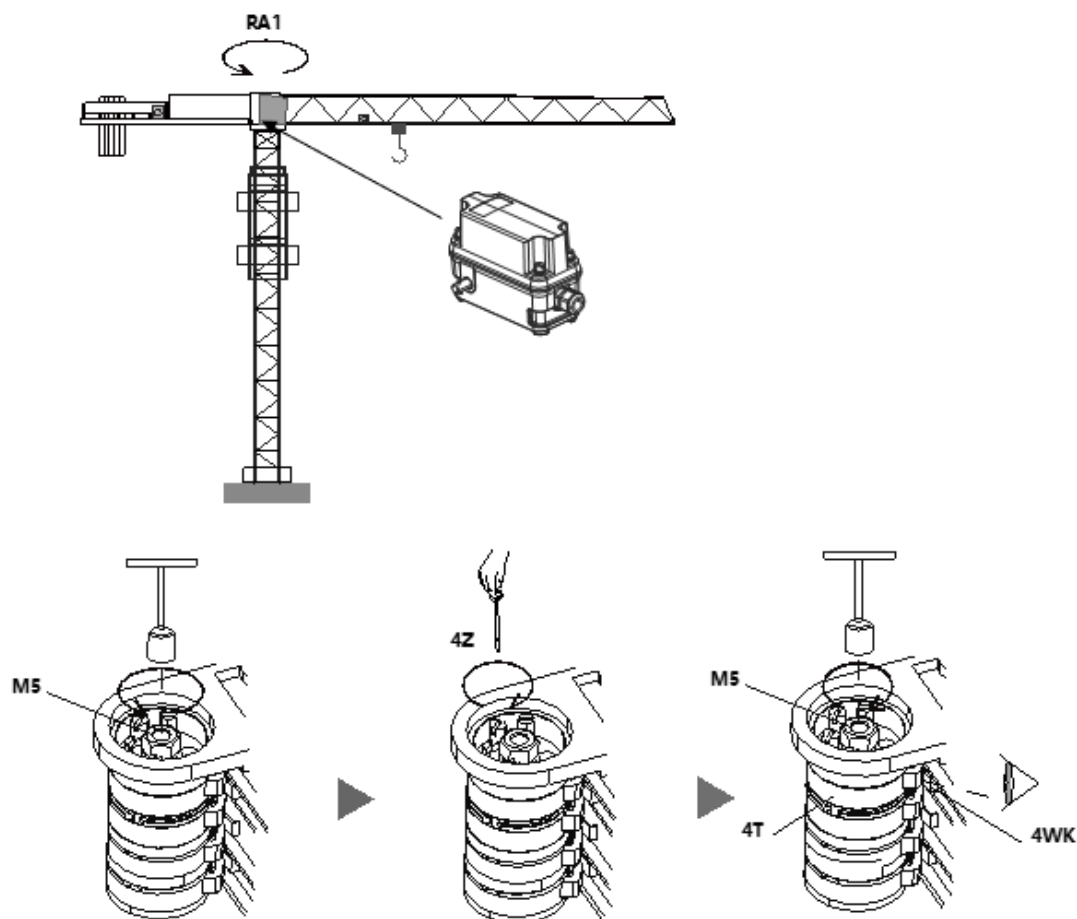


Fig. 4-81 Slewing leftward stop

■ Slewing rightwards stop

After completing the adjustment of the leftwards slewing stop, rotate RA2 clockwise to 1080° (3 turns), mobilize the adjustment shaft (2Z), make the long cam (2T) move to the micro switch (2WK) momentarily switch, and tighten the M5 nut.

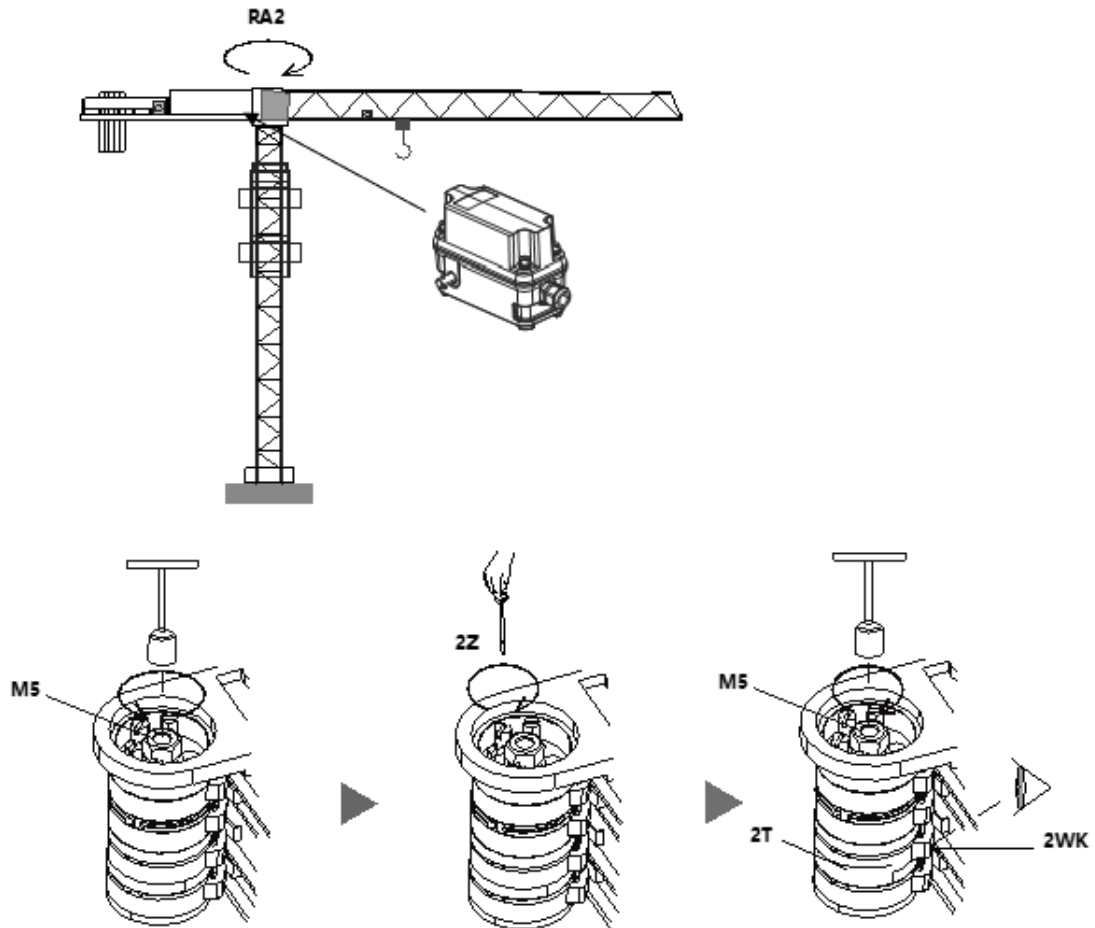


Fig. 4-82 Slewing rightwards stop

■ Multi-function limiter adjusts parameters

Table 4-39 Multi-function limiter adjust parameters

Hoisting limiter			Trolley limiter	
Fall	H1(m)	H2(m)	L1(m)	L2(m)
	7	1.5	5	0.5
	4	1.5		

4.22.4 Anemometer and obstruction light setup

4.22.4.1 Anemometer setup

If tower crane height over 50m, should install anemometer. The anemometer co-work with safety monitor system. When wind speed over the maximum in service wind speed, alarming stop working.

Anemometer installed at the tower head. Shows in fig 7-90, the base (1) connects with tower head through the install plate bolt. Wiring through the wire junction gate (2), and using fan (3) for speed measurement.

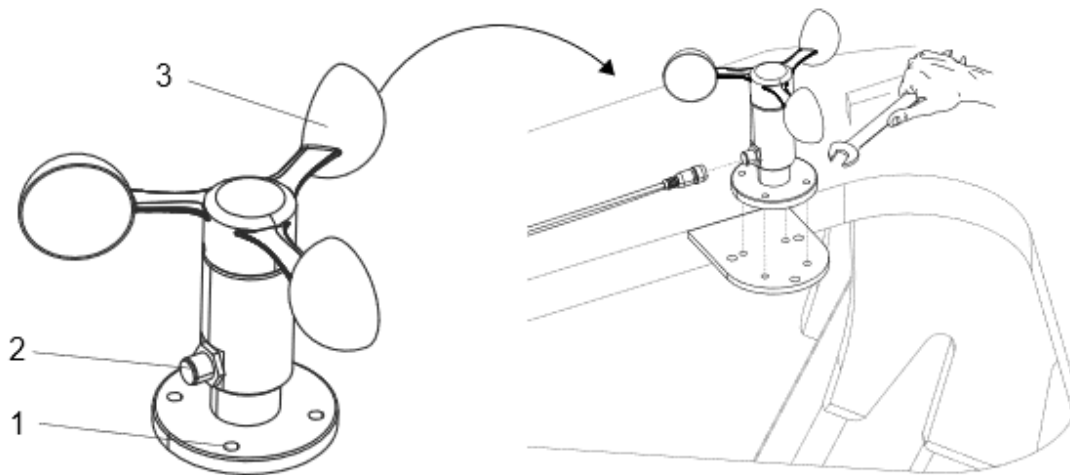


Fig. 4-83 Anemometer

4.22.4.2 Warning and display record device

■ Sound signal



For example, the signals below will produce automatically by the sound warning ways:

- The tower crane starts and self-checks: short buzzer sound for 5 times;
- Warning of over load: constant buzzer sound;
- The tower crane working: intermittent double buzzer sounds.

There will be special sounds according to the local regulations or rules. **Know the tones and last time of each signal!**

■ Light signals



For example, the light signals below indicate particular dangers:

- Wind speed warning at working: flashing orange light.
- Load over 90% of the rated load: flashing orange light (with buzzer warning).
- Limiter failure: flashing red light.

4.22.5 Trolley safety protection device

The safety protection device of the trolley is shown in the following figure:

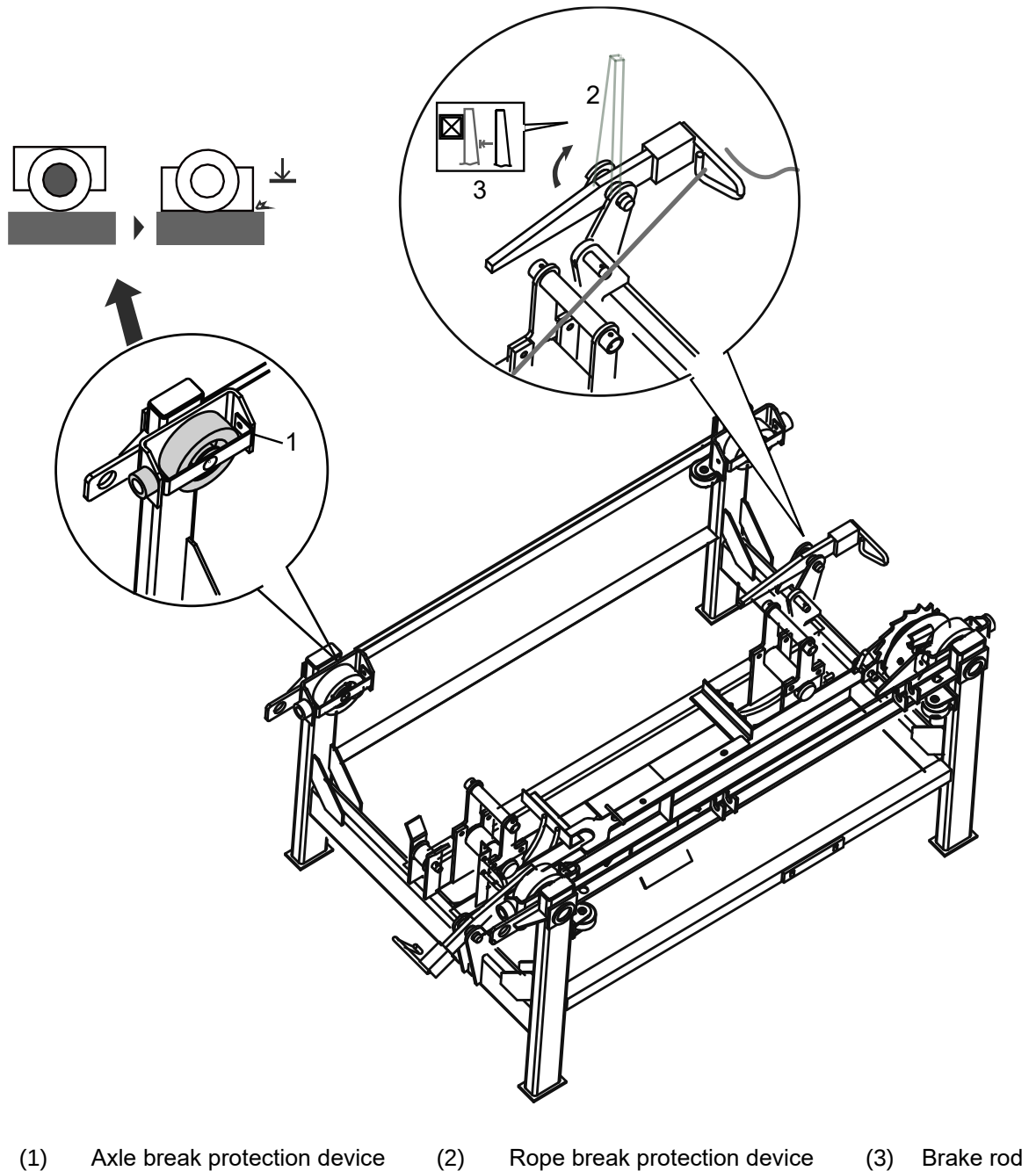


Fig. 4-84 Trolley safety protection device

■ Rope break protection device

As shown in Figure 7-91, under the normal working state of the trolley, the wire rope is in a tensioned state, and the broken rope protection device (2) is in a horizontal state; when the rope is broken, the broken rope protection device rotates to a vertical position under the action of gravity at the tail. In the straight state, at this time, the brake lever (3) of the device will be in contact with the web rod on the bottom surface of the boom, and the movement of the trolley will be blocked and the operation will be stopped automatically.

■ Axle break protection device

As shown in Figure 7-91, when the roller breaks the axle, the trolley loses the support of the roller and moves downward, and the lower end of the axle break protection device (1) is in contact with the lower chord of the boom. Under the action of the four axle break protection devices, the trolley continues to stay on the lower string of the boom to ensure that it will not fall due to the broken axle.

4.22.6 Hook safety device

The hook safety device is shown in figure (1) below, it is in close contact with the hook end face (2) during use, and can only be opened in one direction into the hook. When lifting heavy objects, the objects in the hook will be restrained in the hook by the safety device to prevent decoupling.

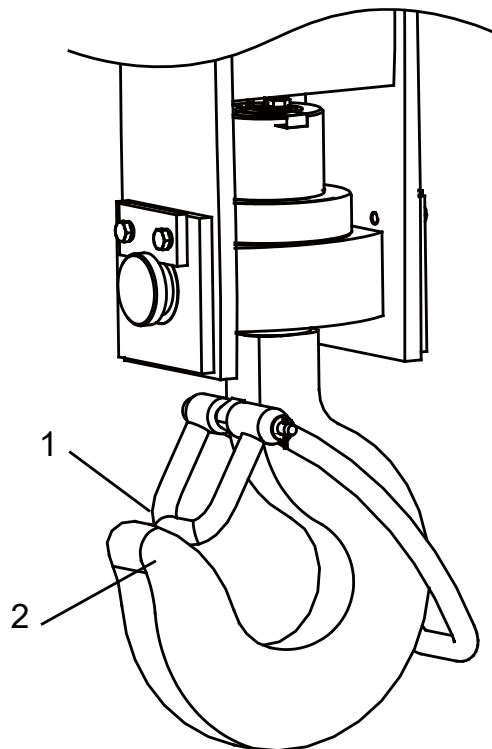


Fig. 4-85 Hook safety device

4.23 Test

To confirm the tower crane's readiness, an acceptance test shall be performed. The test shall include at least the following items:

- Nameplate of the tower crane and the grades;
- Tests of drive mechanism, limiter and indicator;
- Safety devices;
- In compliance with the load tests 4.23.1 and 4.23.2

4.23.1 Function test without load

All functions (such as braking, system controlling and limiting etc.) shall be tested for reliability throughout the whole range of admissible movements up to the maximum operating speed (such as hoisting, trolley and slewing).

- When testing, the temperature should be -15~40°C, the wind speed can't be over 8.3m/s.
- When testing the trolley speed, total time of trolleying, slewing speed, working speed and side perpendicularity, the wind speed can't be over 3m/s.
- The error range of the power voltage should be $\pm 10\%$.
- The participators must have relevant certification.

4.23.2 Load tests

4.23.2.1 Nominal load tests

The load at the maximum amplitude is 25%, 50%, 75%, 100% separately to the nominal load, the tests should comply with the acquirements in 4.23.1, all the tests should be reliable.

4.23.2.2 Static tests with load 125% of the rated capacity

After the success of the no-load test and the nominal load test, proceed the static overload tests. The load tests result for different jib lengths show as Table 4-40.

- Test at 2-fall or 4-fall.
- Hoist the rated load to the position 100~200mm above ground, standstill then add the load to 125% in several times, measure the load height, measure again after 10min, compare the heights.
- There should be no ruptures, permanent deformations or damages affecting the function or safety of the crane and parts connecting loose.

Table 4-40 Static tests with load 125% of the rated capacity

Item Jib length	Fall	Radius I (m)	Load I (t)	Radius II (m)	Load II (t)
80m	2	43.5	40	80	19.5
	4	22.7	80		16.5
75m	2	44.2	40	75	21.5
	4	23.0	80		18.5
70m	2	44.6	40	70	23.6
	4	23.2	80		20.6
65m	2	45.0	40	65	26.1
	4	23.4	80		23.1
60m	2	45.4	40	60	29.0
	4	23.6	80		26.0
55m	2	45.7	40	55	32.4
	4	23.8	80		29.3
50m	2	45.7	40	50	36.1
	4	23.8	80		33.1
45m	2	45.0	40	45	40.0
	4	23.8	80		37.6
40m	2	40.0	40	40	40.0
	4	23.8	80		43.5
35m	2	35.0	40	35	40.0
	4	23.8	80		51.0
30m	2	30.0	40	30	40.0
	4	23.8	80		61.3



- *It is forbidden to trolley and slew at the static overload test.*
- *It is forbidden to adjust the brake at the static overload test.*
- *It is allowed to adjust load moment limiter and load limiter at the static overload test.*

4.23.2.3 Dynamic tests with load 110% of the rated capacity

The load tests result for different jib lengths shows as Table 4-41.

Test at 2-fall or 4-fall.

- **Working condition I** : Trolley to the maximum radius of maximum load, loads by 110% maximum load. Test method:
 - Hoisting: Hoist up and down at the rated speed in the whole hoisting range.
 - Trolleying: Trolley in and out at the rated speed in the whole trolleying range.
 - Slewing: Slewing left and right at the rated speed in the whole slewing range. (for the tower crane which can't slew around, the slewing test angle should exceed the max angle.)
- **Working condition II** : Trolley to the maximum radius, loads by 110% rated load at the maximum radius. Test method:
 - Hoisting: Hoist up and down at the rated speed in the whole hoisting range.
 - Trolleying: Trolley in and out at the rated speed in the whole trolleying range.
 - Slewing: Slewing left and right at the rated speed in the whole slewing range. (for the tower crane which can't slew around, the slewing test angle should exceed the maximum angle.)
- **Requirements:**

Test according to the indication above, check if the mechanisms are flexible and their brakes are reliable. Check if there is any loose or break in the mechanisms or structure parts.

Table 4-41 Dynamic tests with 110% of the rated capacity

Item Jib length	Fall	Radius I (m)	Load I (t)	Radius II (m)	Load II (t)
80m	2	43.5	35.2	80	17.2
	4	22.7	70.4		14.5
75m	2	44.2	35.2	75	18.9
	4	23.0	70.4		16.2
70m	2	44.6	35.2	70	20.8
	4	23.2	70.4		18.1
65m	2	45.0	35.2	65	23.0
	4	23.4	70.4		20.3
60m	2	45.4	35.2	60	25.5
	4	23.6	70.4		22.8
55m	2	45.7	35.2	55	28.5
	4	23.8	70.4		25.8
50m	2	45.7	35.2	50	31.8
	4	23.8	70.4		29.1

Item Jib length	Fall	Radius I (m)	Load I (t)	Radius II (m)	Load II (t)
45m	2	45.0	35.2	45	35.2
	4	23.8	70.4		33.1
40m	2	40.0	35.2	40	35.2
	4	23.8	70.4		38.3
35m	2	35.0	35.2	35	35.2
	4	23.8	70.4		44.9
30m	2	30.0	35.2	30	35.2
	4	23.8	70.4		53.9

4.23.2.4 Operation of overload test circuit

If 110% and 125% overload weight test is needed at the construction site, the following steps should be followed for circuit operation:

- 1) When the tower crane is not operation, pull out the XP16 at the lower part of the driving kit in the driver's cab, connect the spare 100% load unlimited test pug to XS16, and then temporarily the mechanical limit of 105% load.
- 2) Rotate the mode section key switch to "Mechanical" mode, when the electronic load limit is not involved in the control, then the overload hoisting test can be performed.
- 3) After the completion of test, open the mode selection key and rotate it to the "electromechanical" mode on the interface of "load weight calibration". Remove the "100% weight unlimited test plug" and connect the weight limiter plug, the system will resume normal operation.



- This operation must be carried out by professional testers.
- The operation shall be carried out in strict accordance with the test process, and illegal driving and taking the plane during the test are prohibited.
- Once test is completed, remove the "100% weight unrestricted test plug",
- This "100% load unrestricted test plug" is guaranteed to be used for temporary overload test on construction site, and must not be removed

4.24 Climbing operation

4.24.1 General notices of climbing operation

- 1) Keep the crane rotation part in balance before climbing.
- 2) It is prohibited to operate the jacking system when the wind speed at the highest spot exceeding 13m/s.
- 3) Make sure that the climbing system works normally before climbing.
- 4) It is prohibited to hoist load (up or down) while the jacking system is in operation or after jacking.
- 5) It is prohibited to move the trolley while the jacking system is in operation or after jacking.
- 6) Keep the jib in the same direction as the in-let tower section during jacking operation. Stop the jib with the slewing mechanism brake and be sure of the trolley stopping at the jack-balanced position.
- 7) If several tower sections are to be added in succession, then after each section is added, the next tower section is hoisted by the mast itself. The mast connected to transition must contain 4 pins of $\Phi 74$. Only in this case can each main chord rods connected transition use 1 $\Phi 74$ pin, shoulder-free pins be permitted for use. Allow to balance hoisting within trim range, but the slewing operation is prohibited.
- 8) Keep the climbing lugs on the newly added tower section in alignment with those on the existed section.
- 9) It is prohibited to slew, change work-radius and hoist load without connection of the slewing ring support to the tower body by $\Phi 75$ pins, except the seventh permit.
- 10) If the jacking hydraulic system has become abnormal in the course of jacking, stop immediately the jacking operation then retract the oil cylinder and lower the slewing ring support onto the top of tower body and use $\Phi 75$ pins to connect the transition to the tower body, and then removing troubles from the hydraulic system.
- 11) After finish jacking, all the connection of tower sections uses 8 pins of $\Phi 75$, the uppermost tower section is connected to transition section by 8 pins of $\Phi 75$ (double head pins).

4.24.2 Assembly of the hoisting frame

Assemble the hoisting frame refer to the figure and parts table below.

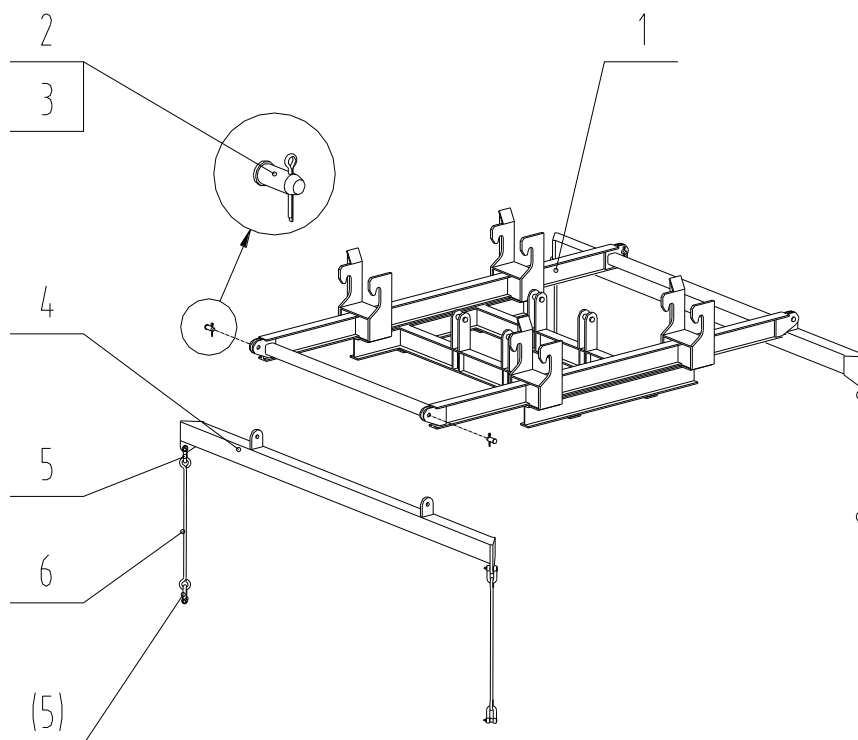


Fig. 4-86 Assembly of the hoisting frame

Table 4-42 Part of hoisting frame

No.	Name	Specification	Qty
1	Support frame		1
2	Pin	Φ30X56X80	4
3	Split pin	GB/T91-2000	4
4	Main beam		2
5	Shackle	JB8112-1999	8
6	Hoisting bar		4

4.24.3 Keep the tower crane in balance before climbing

- 1) Choose the mounting-used falls according to the working falls.
- 2) Assemble the mounting appropriate hook to the hook assembly as the figure below.

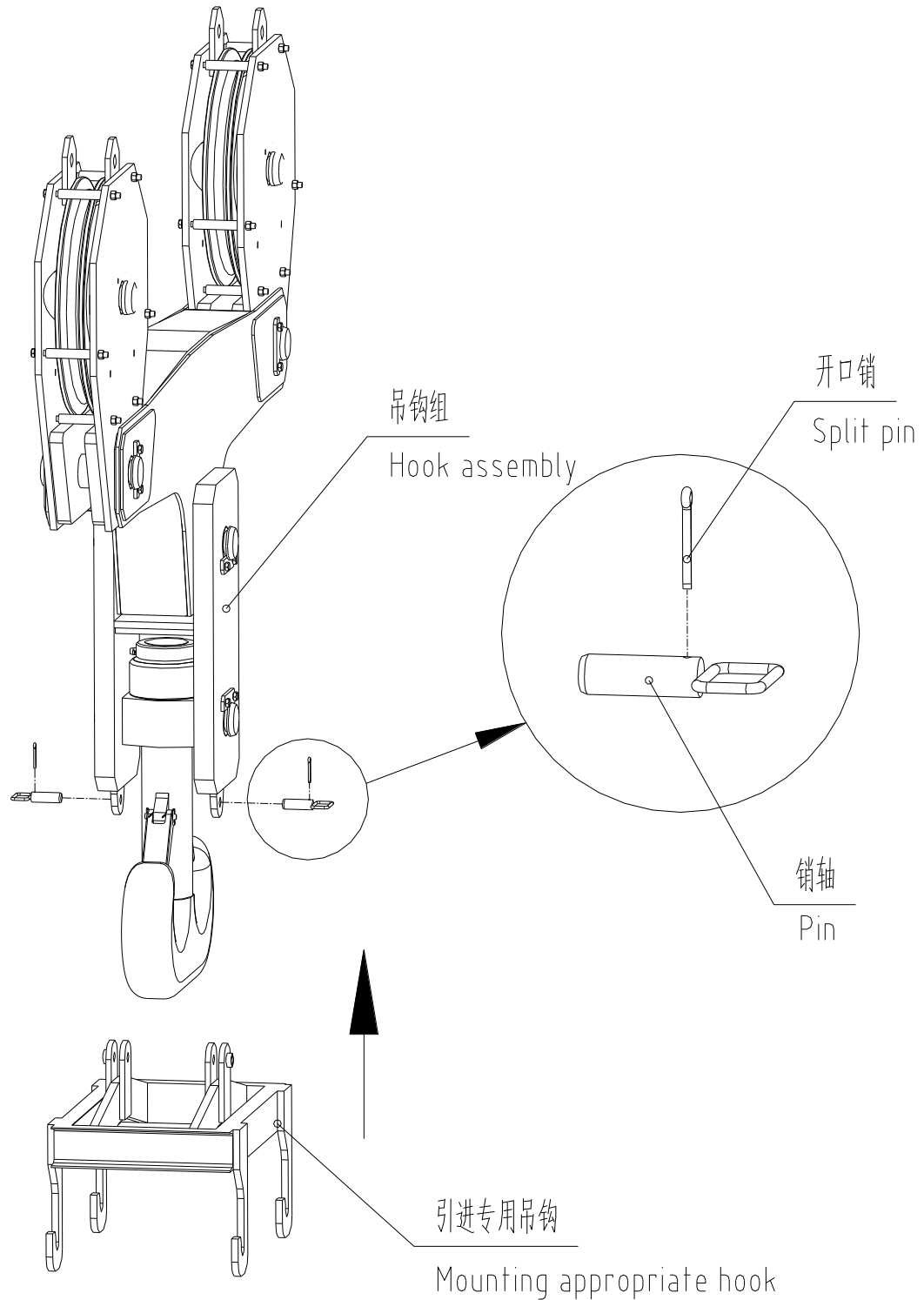
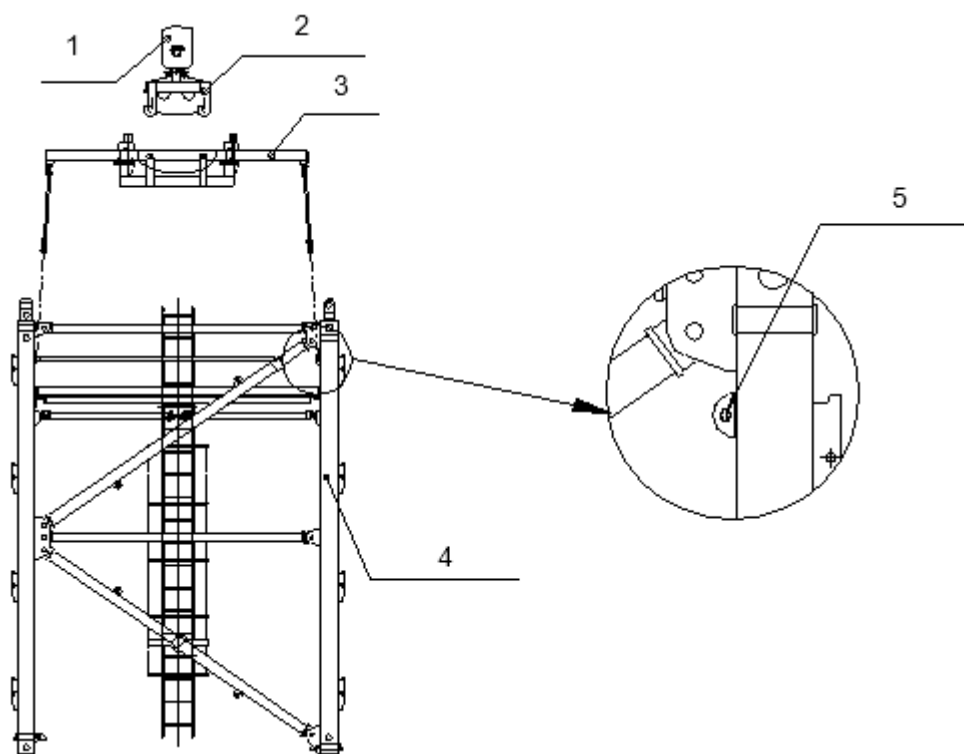


Fig. 4-87 Assembling the appropriate hook to the hook assembly

- 3) Installing the appropriate hook on the hook assembly directly which used to reduce the hoisting frame, refer to the first figure below. The 4 shackles of lower hoisting frame tie the tower section respectively, and then hoisting the tower section, refer to the second (4-fall) and third figure (2-fall) below.



- | | |
|---|-------------------------------|
| (1) Hook assembly | (2) Mounting appropriate hook |
| (3) Hoisting frame | (4) Tower section |
| (5) Mounting hoisting hole (connect to the shackles of the frame) | |

Fig. 4-88 Hoisting tower sections

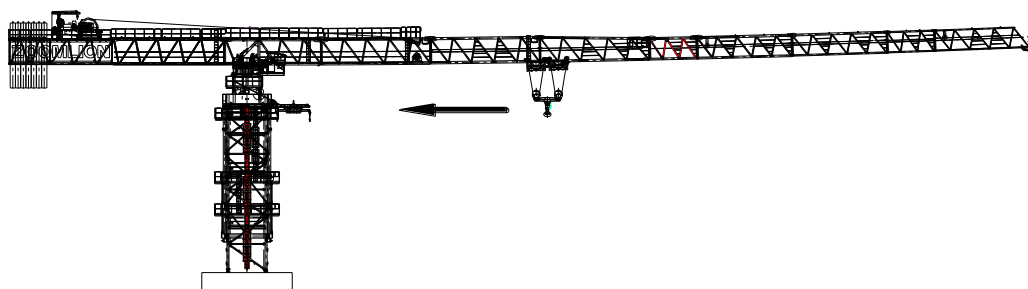


Fig. 4-89 Hoisting tower section at 4-fall

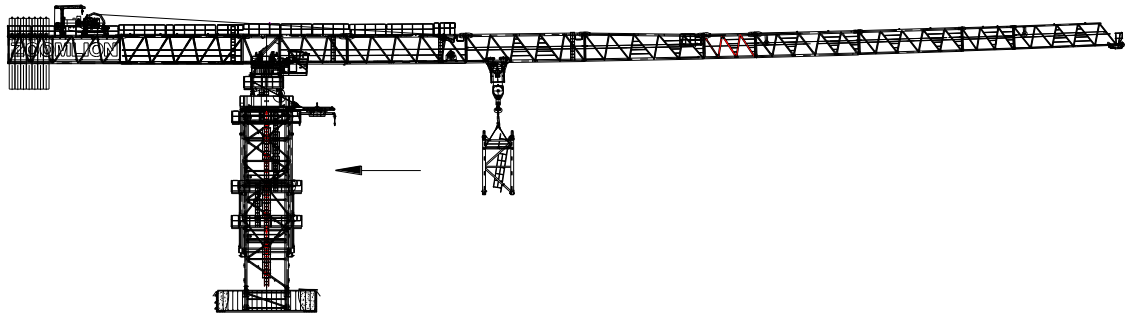


Fig. 4-90 Hoisting tower section at 2-fall

- 4) Operate the trolley mechanism slowly, move internal, the trolley drive to the mounting trolley, hanging the hoisting frame on the mounting trolley, as shown in the first figure below. Put down the rope, so the unhooking of the appropriate hook and hoisting frame have finish, as shown in the second figure below.

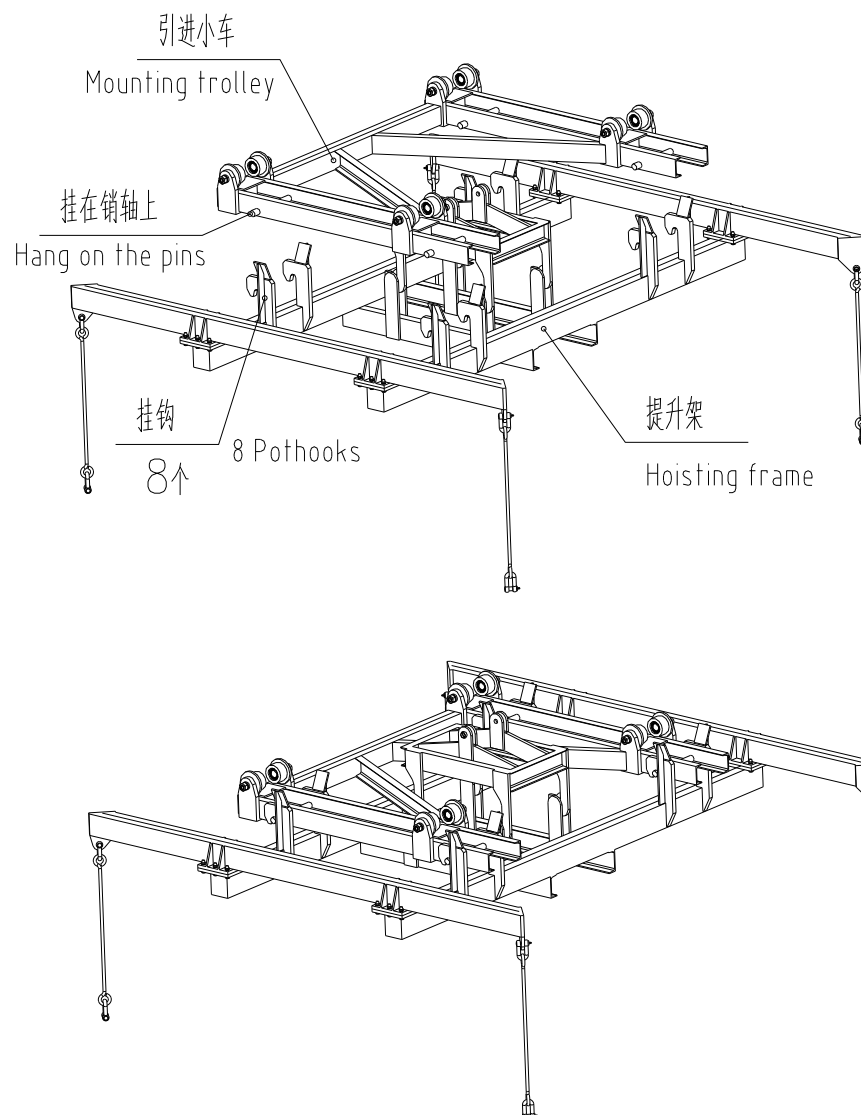


Fig. 4-91 Hang the hoisting frame on the mounting trolley

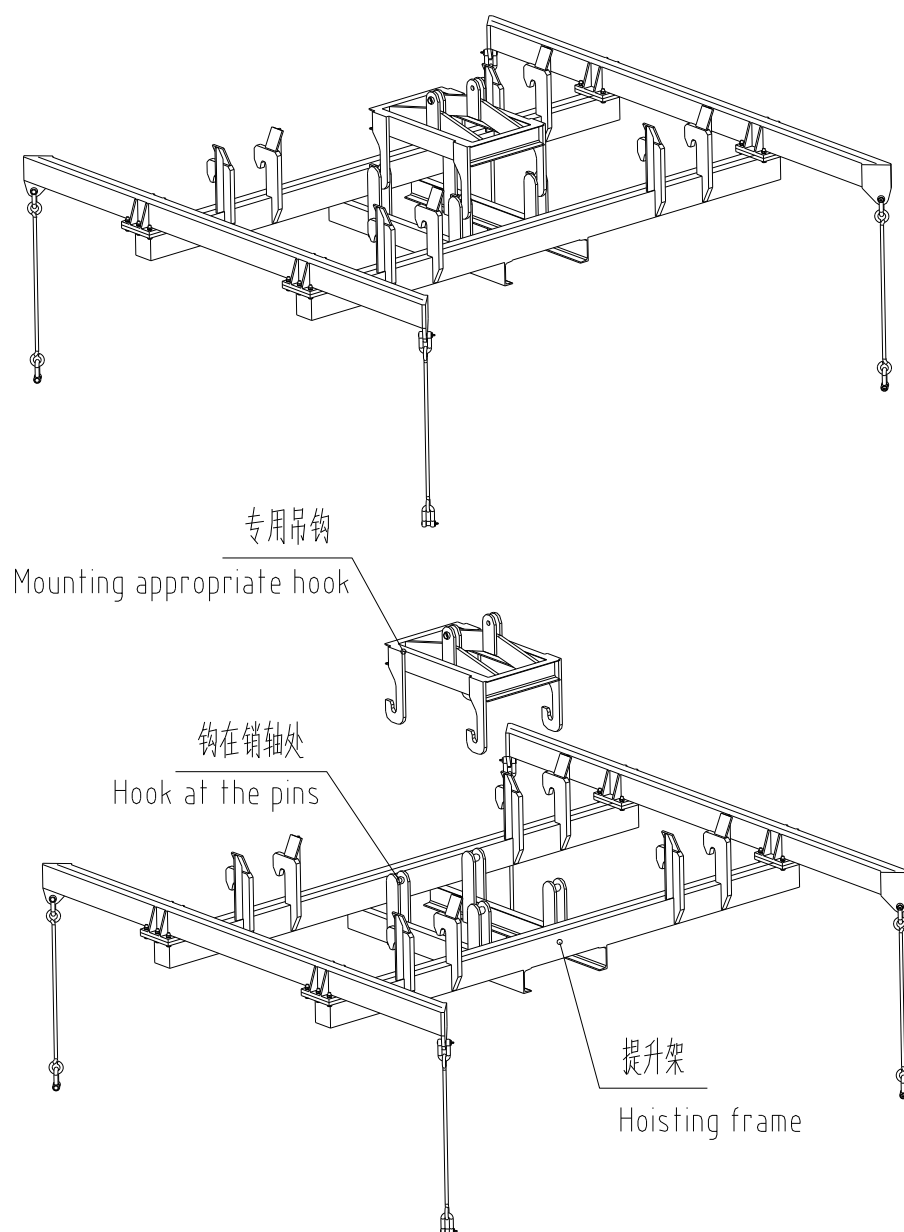


Fig. 4-92 Hang the hoisting frame on the mounting trolley

- 5) Hoist different balance weight and move the trolley to the reference balance position according to the table below, and then dismantling the pins between the 4-outrigger transition beam and tower section.

The balance weight and trolley range for the balancing different jib length is shown as following table (for reference only):

Table 4-43 Balance weight and trolley range for the balancing different jib length (4-fall)

Jib length (m)	Balance lifting weight G (t)	Balance range L(m)
80	17	40.6
75	17	40.7
70	17	40.5
65	17	40.4
60	17	39.3
55	17	42.0
50	17	39.9
45	30	27.2
40	30	26.5
35	35	27.4
30	35	27.6

- 6) Push the handle of the hydraulic climbing system to “climbing direction”, drive the climbing equipment to the position where the outriggers of the transition section leave the chord of the mast just now.

- 7) Check if the outriggers connecting the transition section and tower section are align to the main chords of the mast at the same vertical line. Observe the gaps between the 16 guild wheels of the climbing equipment and the main chords of the mast and check if the gaps are almost the same. Check if the tower crane is balanced, if not, adjust the range of the trolley until the center gravity of the upper crane is locating at the center of the mast. Refer to the figures below.

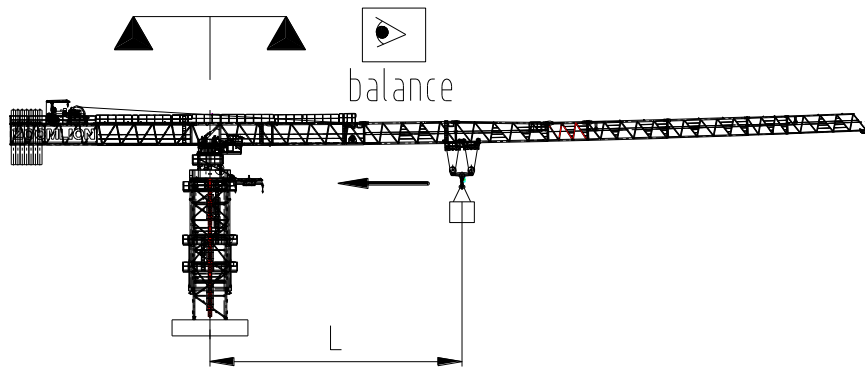


Fig. 4-93 Climbing balance of 4-fall

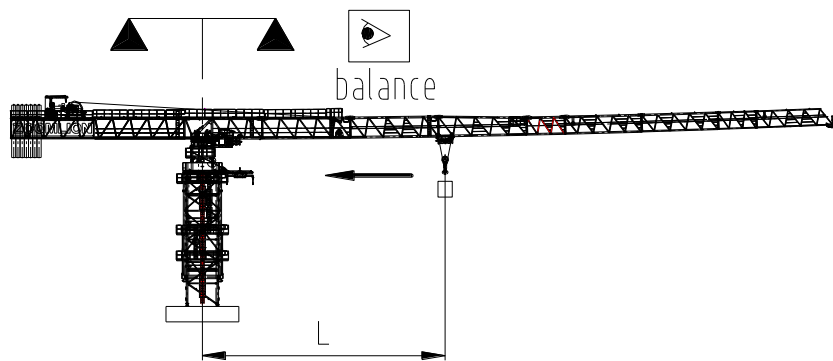


Fig. 4-94 Climbing balance of 2-fall

- 8) Record the balance positions of the trolley, but notice that the positions are different for different jib length;
- 9) Operate the hydraulic climbing system to drive the climbing equipment down, install the connecting pins between the transition section and the tower sections.

4.24.4 Climbing processes

- 1) Use the brake on the slewing mechanism to hold the tower superstructure at a slewing braking status, thus ensuring no slewing movements.
- 2) Dismantle 8 pins of $\Phi 75$ which connecting the tower head and the transition beam, save them on the platform;
- 3) Turn the step changing control handle up to make the step-changing support rods incline to outside so to avoid intervening steps when climbing. Lock the handle when the plate moves to appropriate position;

- 4) Start the hydraulic climbing system, extend the climbing oil cylinder to set the 4 climbing hanging plates to the channels of step A, then insert the safety pins. Refer to the figure below.



In the process, there must be someone professional to observe if the climbing cross beam is set in the channels and insert the safety pins!

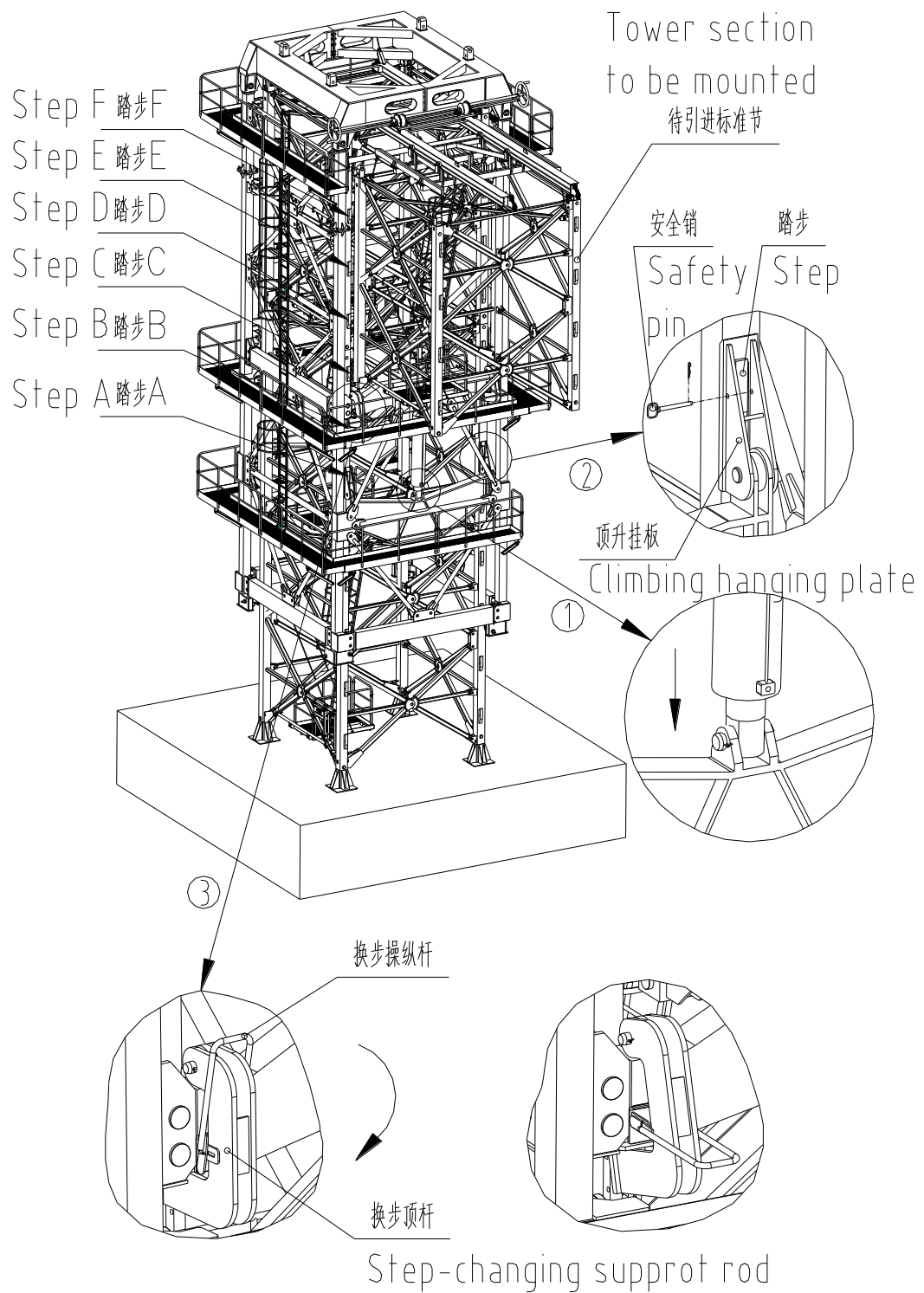


Fig. 4-95 Step ① of Climbing processes

- 5) Ensure the climbing hanging plates are set in the channels and the safety pins are inserted in, keep climbing until the climbing equipment and the upper parts is lifted for 10~50mm;



Keep the state for nearly 20 minutes, check if there are any abnormal sounds, shifting, transformation in the force bearing parts of the climbing equipment, climbing hanging plates for example; check if there is abnormal phenomenon such as automatic shrinking on the piston rod of the oil cylinder. Only when the check results are OK, the climbing processes can continue to be executed.

- 6) Keep climbing after checking the parts are OK; jack up the climbing equipment to make the step-changing support rods be a little higher than the step C of the tower section (the initial position is above the step B), then stop climbing;
- 7) Shrink the oil cylinder slowly, turn the step-changing control handle down to make the step-changing support rods incline inward to be vertical and place in the channels of step C. Refer to the figure below.

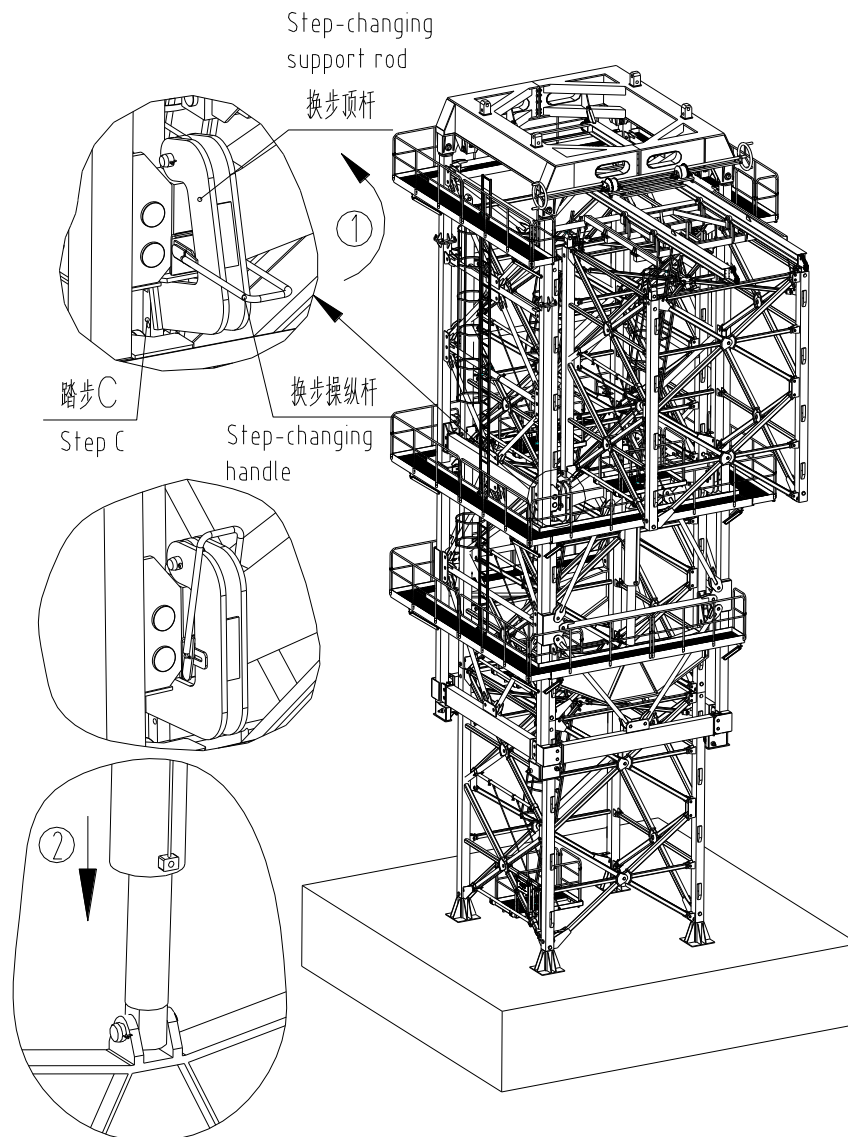


Fig. 4-96 Step ② of Climbing processes

- 8) Ensure the 4 step-changing support rods are pressing at the step channels of step C and standing the weight of the climbing equipment and the upper parts, and make sure there is no abnormal phenomenon such as transformation, abnormal sounds. Confirming OK, pull the safety pins from the climbing hanging plates, shrink all the pistons of the oil cylinder, then the climbing hanging plates rise, place in the closest channels of step B **and insert the safety pins**.

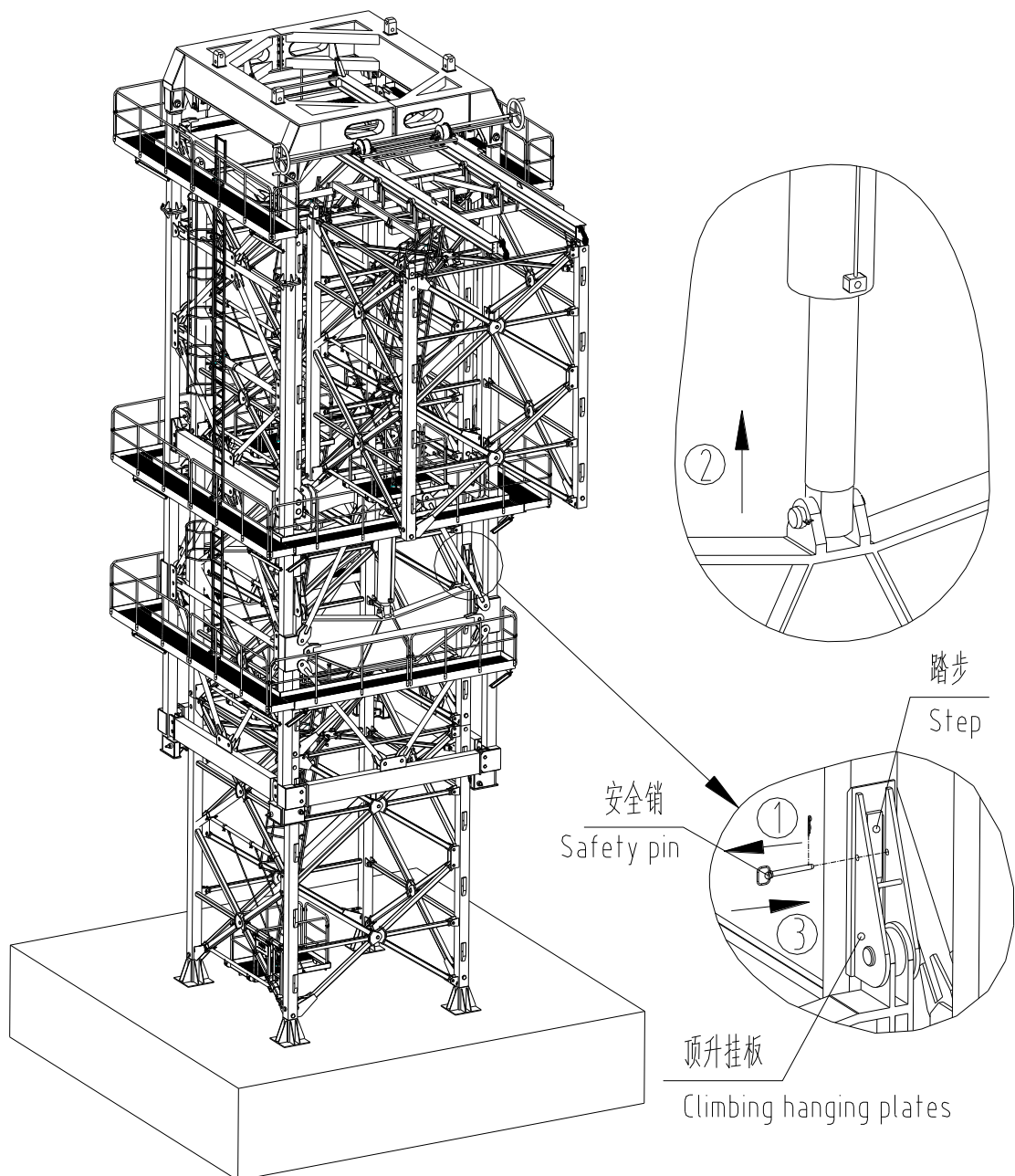


Fig. 4-97 Step ③ of Climbing processes

- 9) Turn the step changing control handle up to make the step-changing support rods incline to outside so to avoid intervening steps when climbing. Lock the handle when the rods move to appropriate position;
- 10) Extend the oil cylinder again, jack the climbing equipment up, make the step changing plates a little higher than the step D. Shrink the oil cylinder slowly, turn the step changing control handle down to make the step changing plates incline inward to be vertical and place in the channels of step D;
- 11) Ensure the four step-changing support rods are pressing the step D channels and standing the weight of the climbing equipment and the upper parts, and make sure there is no abnormal phenomenon such as transformation, abnormal sounds. Confirming OK, pull out the safety pins from the climbing hanging plates, shrink all the pistons of the oil cylinder, then the plates rise, place in the closest channels of step C **and insert the safety pins**. Turn the step changing control handle up to make the step-changing support rods incline to outside.
- 12) Operate as the proesses (6) and (10) until the step-changing support rods are all set on the step F of the tower section and standing the weight of the climbing equipment and the upper parts, **then pull out the safety pins**, shrink all the pistons of the oil cylinder, then the hanging plates rise and hang on the step E channels, **then insert the safety pins**.

- 13) Turn the step changing control handle up to make the step-changing support rods incline toward outside. Start the oil cylinder at the time, when it extends completely, there is a space bigger than one tower section above the mast. Refer to the figure below.

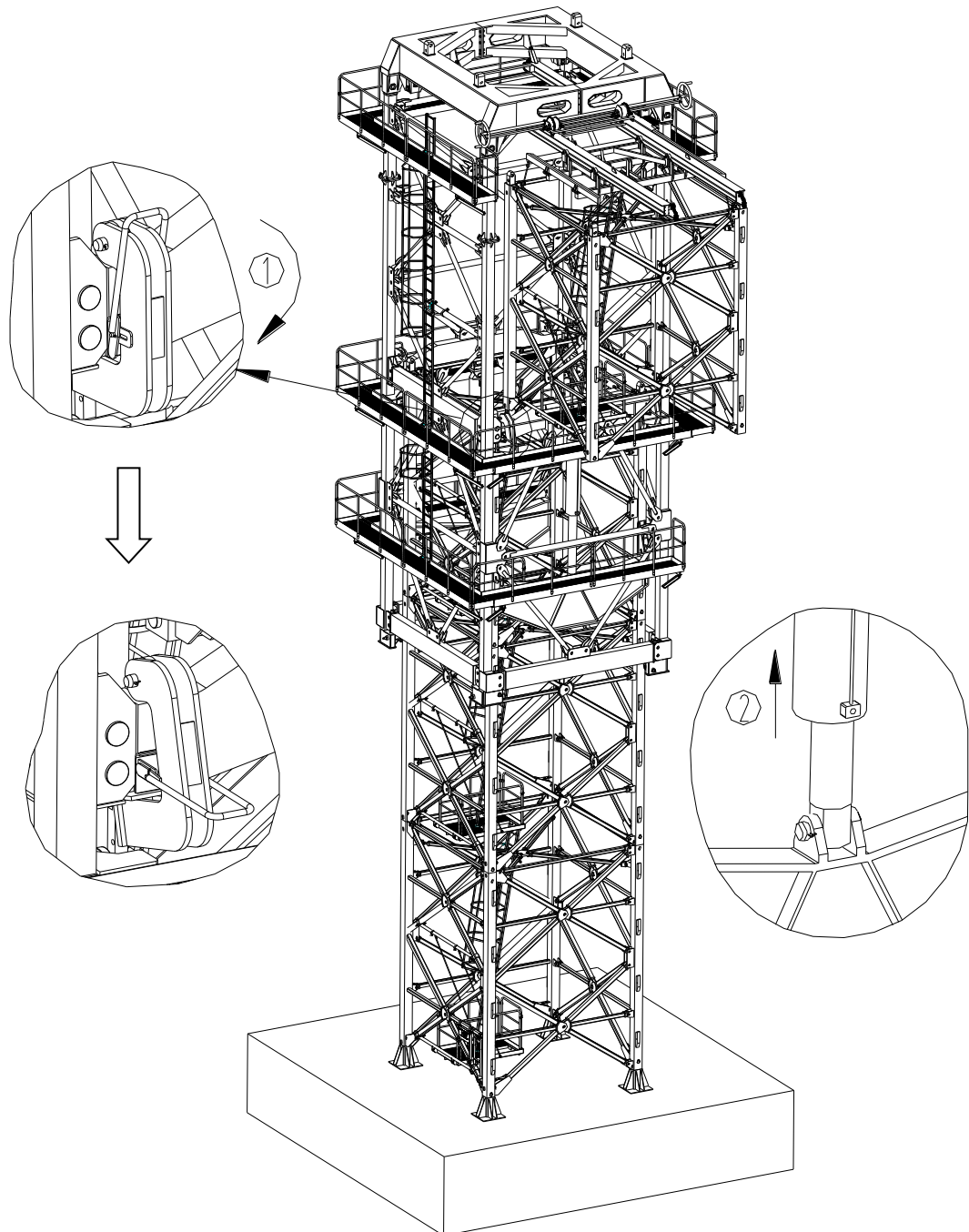


Fig. 4-98 Step ④ of Climbing processes

- 14) Mount the tower section to the right above the mast, align the tower section to the mast, shrink the oil cylinder slowly until the mounting tower section touch the surface of the uppermost tower section of the mast completely. Then insert 8 pins of $\Phi 75$ into the connecting holes and insert split pins and spring pins. Then remove the 4 shackles. Refer to the figure below.

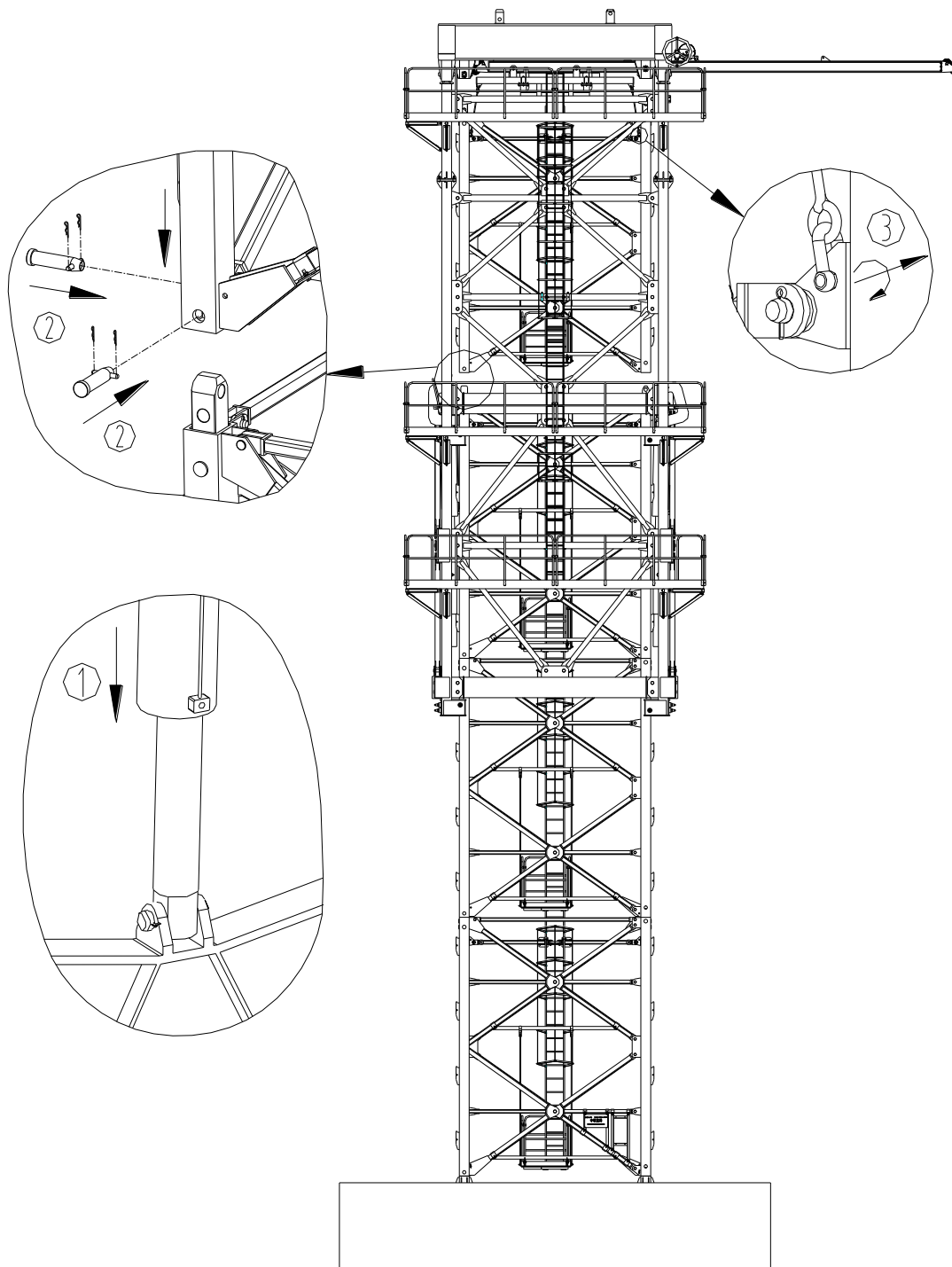


Fig. 4-99 Step ⑤ of Climbing processes

- 15) Refer to the figure below, turn the step changing control handle up, move the mounting trolley and hoisting frame to the outside of the mast, keep on shrinking the oil cylinder until the outriggers of the transition beam and the mounting tower section touch each other completely. Then insert 8 no-shoulder pins of $\Phi 75$ and insert lock pins and spring pins into the pin ends (Refer to the Table 4-5).

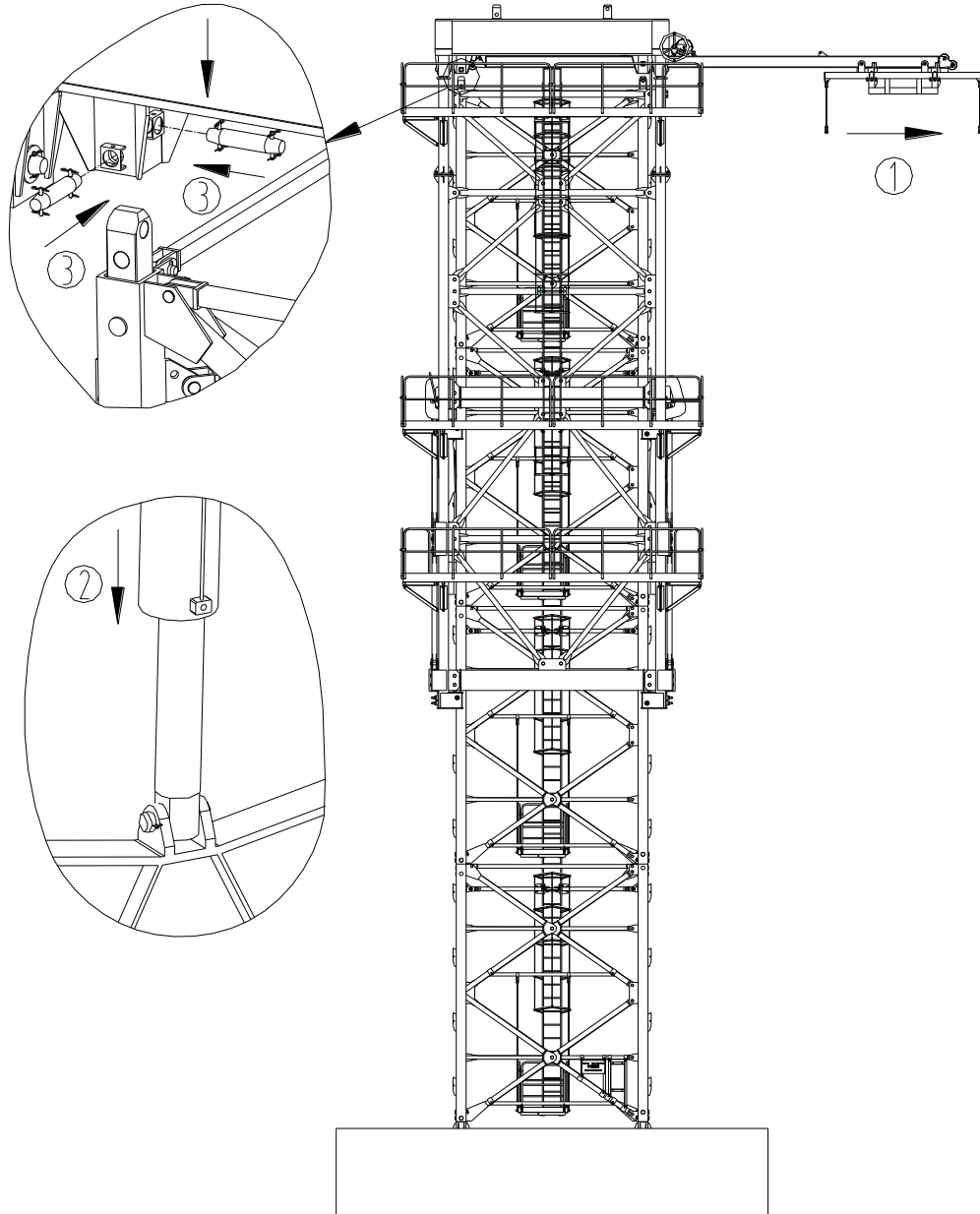


Fig. 4-100 Step ⑥ of Climbing processes

- 16) Until here the climbing processed of one tower section is done, if it is needed to climb more tower section, follow and repeat the processes above.



When climbing for several tower sections continuously, the 8 pins connecting the transition beam and the mast can be replaced by 4 temporary pins which a little smaller than the standard pins. When the climbing processes are all done, the 4 temporary pins must be replaced by the 8 standard pins.

4.25 Dismantling

4.25.1 General notes

- 1) Due to the climbing mechanism out of service for a long time, conduct maintenance and test-run for the climbing mechanism before moving the tower crane out of the construction site.
- 2) Before dismantling of tower crane, maintenance and test-run of the climbing mechanism is necessary.
- 3) Check limiters, slewing mechanism brakes and similar for reliability during test-run.
- 4) It is prohibited to use the slewing mechanism, trolley and hosting mechanism before the tower crane mast sections have been dismantled and the slewing support has not been connected to the tower body by eight pins.
- 5) Check frequently the main stressed parts of the climbing mechanism, as the tower crane dismantling is a heavy duty and successive work for the climbing mechanism.
- 6) While the climbing mechanism is working, all operating personnel are required to focus their attention on observing the relative positions of moving parts for normal condition (e.g. between guide rollers and main chord rods, between Telescopic cage and crane tower.). In case of any deviation during the telescopic cage is being lifted, stop and lower climbing immediately.
- 7) Carry out dismantling when the wind speed is lower than 14m/s atop the tower crane. Take care of the stockpile location of dismantled parts because the working site is limited for tower crane dismantling after the buildings have been constructed. Any slight carelessness might cause serious accident.



- Users are required to strictly follow the Instructions-specified rules to dismantle tower crane. Operators shall have been trained and with certificates. Any slight neglect will cause machine damage, personal injury or death.
- Pay great attention to the two moving mast lugs during inlet or dismantle of additional mast sections. Inspect if the lugs are still in proper level condition.
- Pay great attention to the two climbing latches during inlet or dismantle of tower section. Inspect if the latches are still in proper level condition. Slewing the tower crane to the dismantling area where there shall be no obstacles influencing the operation. Carry out tower crane dismantling according to the sequence. Its steps are in opposition to the steps of tower crane erection. Strictly follow the instructions specified rules in all cases.

4.25.2 Dismantling sequences

The dismantling sequences of **outrigger stationary tower crane** are as following,

- 1) Dismantle the warning light, camera and anemometer;
- 2) Dismantle mast sections, but reserve the base tower section, two tower sections (3 tower sections for the stationary / travelling chassis tower crane);
- 3) Remove the hoisting rope and trolley rope;
- 4) Dismantle counter ballasts from counter jib, but reserve the first 12.5t counter ballast;
- 5) Dismantle the jib assembly, but reserve the jib I , II ;
- 6) Dismantle the first 12.5t counter ballast;
- 7) Dismantle the derrick;
- 8) Dismantle the hoisting mechanism;
- 9) Dismantle the counter jib;
- 10) Dismantle the II (with trolley mechanism);
- 11) Dismantle the jib I (with trolley);
- 12) Dismantle slewing unit (mainly consists of turntable, slewing ring, Slewing support, slewing mechanisms, cabin, resistor cabinet, electric control cabinet);
- 13) Dismantle the transition beam and mounting device;
- 14) Dismantle climbing unit;
- 15) Dismantle the rest tower sections and base tower section.

For the stationary chassis tower crane:

- Displace the central ballasts;
- Dismantle the chassis.

For travelling chassis tower crane:

- Drive the crane to the dismantling area **before dismantling**;
- Fold down the rail clamps of the bogies and tighten them onto the rails **before dismantling**;
- Displace the central ballasts;
- Dismantle the chassis.

4.25.3 Dismantling warning light, camera and anemometer

4.25.4 Dismantling the tower section

- 1) Slewing the jib to the inlet direction (the side with opening of the climbing equipment). The slewing braking is start-up. Let the tower crane is in balance. The trolley is stopped at the root of jib which is the balance.

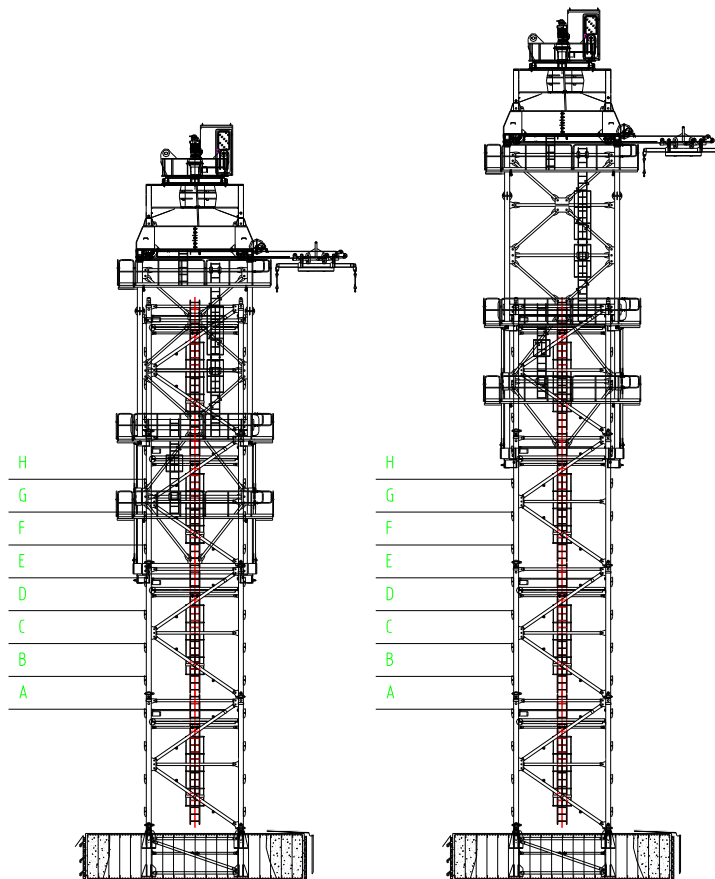


Fig. 4-101 Step ① of dismantling the mast

- 2) Extend the climbing oil cylinder to support the climbing beam to the step F, insert the safe pins, dismantle the pins which connecting the uppermost tower section and the transition beam. **CAUTION: Turn the step changing control handle up to make the step changing plate incline to outside so to avoid intervening steps when climbing. Lock the handle when the plate moves to appropriate position.**
- 3) Observe if the crane is balance. When it is balance, extend the oil cylinder slowly, support the climbing equipment and the upper structure. At the time, the uppermost tower section takes apart with the transition beam. Continue extending the oil cylinder until the distance between the uppermost tower section and the transition beam can accommodate the mounting trolley. Start the mounting device, mounting in the trolley to the upside of the tower section in the climbing equipment. Adjust the length of oil cylinder, use 4 shackles to connect the rope and lugs of the uppermost tower section. Dismantle the pins which connecting the uppermost and second upper tower section.

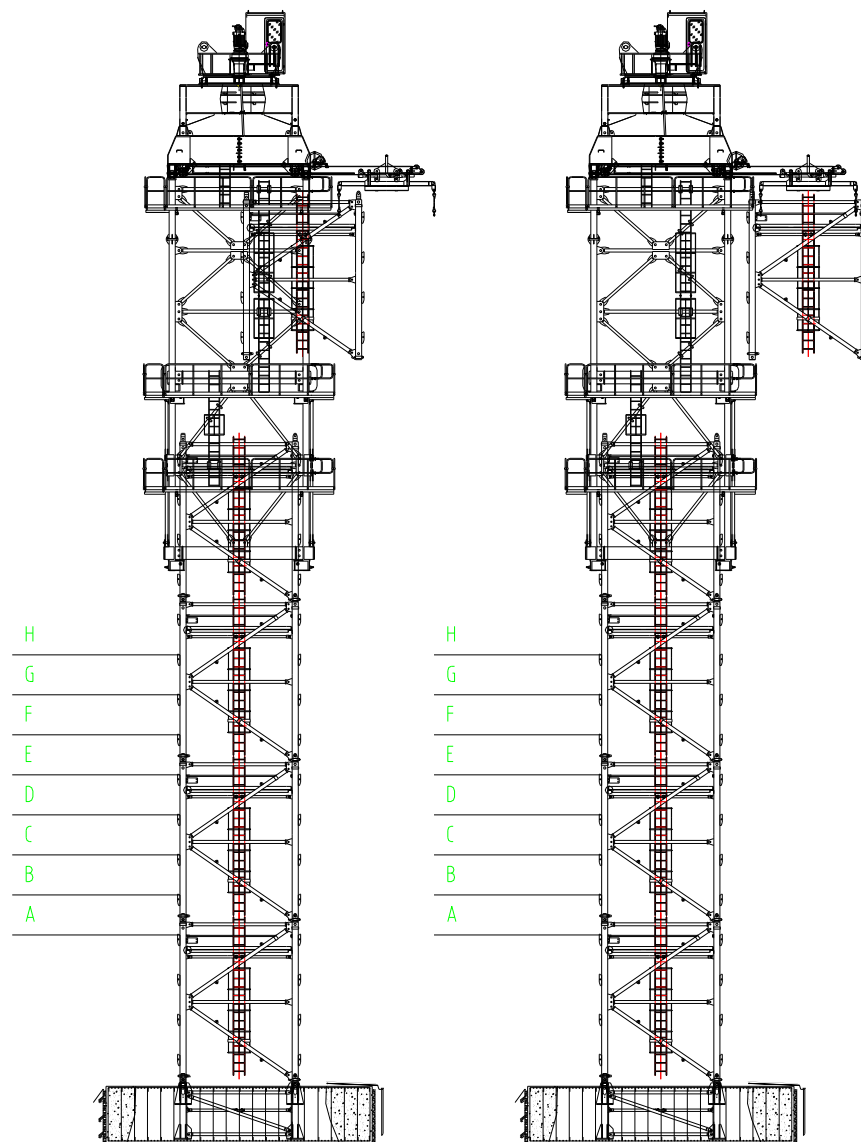


Fig. 4-102 Step ② of dismantling the mast

- 4) Extend the oil cylinder slowly, hoist the tower section which connected to the hoisting frame until the two tower sections take apart completely. Stop the climbing now and start the mounting device, send out the tower section. Then contract the oil cylinder to appropriate position, turn the step changing control handle to make the step changing plates place on the step H.
- 5) Make sure the four plates are all placing on the channels of the H step and standing all the weight of climbing equipment and the upper parts. Pull out the safe pins on the climbing beam, extend the oil cylinder to make the beam hang on the channel of the E step, then insert the safe pins.
- 6) Extend the oil cylinder slowly, make the step changing plates higher than the upper plane of the step H. Turn the step changing control handle up to make the step changing plate incline to outside so to avoid intervening steps when climbing. Lock the handle when the plate moves to appropriate position.

- 7) Contract the oil cylinder to appropriate position, turn the step changing control handle to make the step changing plates incline inward to be vertical and place on the step G.

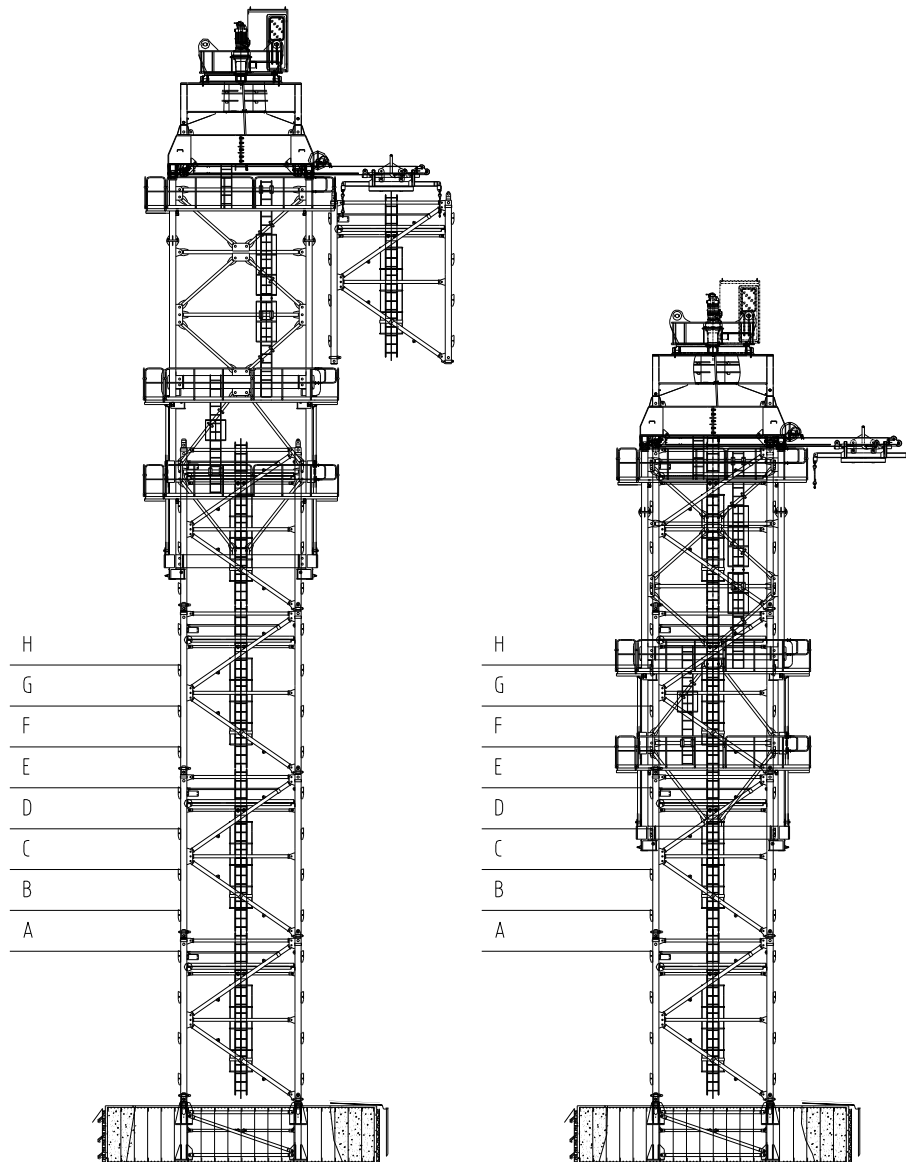


Fig. 4-103 Step ③ of dismantling the mast

- 8) Repeat the step 5~7 until the hoisting beam place on the channel of step A finally. Continue extending the oil cylinder until the transition beam get back to tower sections, align the pin holes and insert the 8 pins of $\Phi 75$. Make sure the hole directions on the end of the pins align to the hole directions of the transition beam before inserting in, then insert the lock pins and spring pins.
- 9) Firstly, start the hoisting mechanism to put the tower sections (or other weight) which for balance on the ground. Then start the trolley mechanism, put the tower sections to ground by the trolley and hook of the crane and the special trolley and hook of the mounting device. If it is needed to dismantle several tower sections continuously, the 8 pins of $\Phi 75$ for connecting the mast and slewing support can be replaced by 4 temporary pins which a little smaller than the standard pins (CAUTION: every outrigger for one pin). operate according to the steps above. When the dismantling finished, the 4 temporary pins must be replaced by 8 standard pins.



In the process of climbing equipment moving down, there must be someone to observe the climbing beam, step changing plates and guild pulleys, and checking if the climbing equipment is intervening by barriers.

After dismantling the tower sections until only one base tower section and two tower sections remaining, it is needed to dismantle the head of the crane (counter jib, jib, etc.) continuously. Refer to the following sections for further information.



When the climbing equipment is falling, if the jacking rod of the climbing equipment is connected with the tower section's connecting bolts, it is advised to turn over the rod manually. Special persons guard the jacking rod, climbing beam and rollers, observe the jamming problems when descending the climbing equipment for it lowers successfully.

4.25.5 Dismantling the hook and the hoisting wire rope

- 1) The dismantling processes of rope are reverse with the rolling processes;
- 2) Drive the trolley to the tip of the jib and put down the hook to temporary support on the ground, so that the rope is unstressed;
- 3) Fix the rope to the trolley by rope clamps, and dismantle the wedgy connector from the anti-twist device;
- 4) Start the hoisting mechanism slowly to the position of almost 1m from the ground, check if the rope is stable;
- 5) Drive the trolley to the root of the jib, put down the hook and fix it to the temporary support;
- 6) Remove the connecting between the rope and wedgy connector, then loosen the rope clamps;
- 7) Start the hoisting mechanism slowly, dismantle the rope according to the order: hook, the pulley groups of trolley, guild pulley, hoisting weight limiter, rope rod, puck up the rope to the hoisting mechanism at last.

4.25.6 Dismantling the trolley wire rope

Drive the trolley to the root of the jib and then dismantle the rope.

4.25.7 Dismantling the electric control wire

Disconnect the electric control wire which influences the hoisting of the tower parts, circle towards one direction.

4.25.8 Dismantling the counter ballasts but the first

Dismantle the counter ballasts one by one in reverse order of installing the counter ballast. Reverse the first counter ballast of **12.5t**.

4.25.9 Dismantling the jib assembly (except the jib I , II)

- 1) Fix the trolley to the root of the jib;
- 2) Dismantle the pins between the jib assembly (except the jib I , II) and the jib II ;
- 3) Hoisting the jib assembly (except the jib I , II);
- 4) Lower the jib assembly down and lay it down on the sleeper-cushioned support.

4.25.10 Dismantling the first counter ballast

Remove the first counter ballast and lower it down on the ground.

4.25.11 Dismantling the derrick and hoisting mechanism

Dismantle the derrick and hoisting mechanism according to the reverse order of **Section 4.11** and **Section 4.10**;

4.25.12 Dismantling the counter jib

- 1) Lift and hold the counter jib, jack up the counter-jib tie bar support and fix it by pins;
- 2) Take connecting pins on the upper chords of counter jib and jib I as fulcrum, lift the rear part of counter jib up a little, make the counter-jib tie bars in release, set the long tie bars on the support, remove the connecting pins between the long and short tie bars.
- 3) Lower the counter jib down and place it to proper position on the ground.

4.25.13 Dismantling the jib I , II

Lift and hold the jib II , remove the connecting pins of jib II and jib I , lower the jib II down, then place it to the proper position on the ground. Dismantle the jib I in the same way.

4.25.14 Dismantling the slewing unit

Hoist the slewing unit and dismantle the pins between slewing support and transition beam. Place the slewing unit to proper position on the ground.

4.25.15 Dismantling the transition beam and mounting device

Lift and hold the transition beam and mounting device, remove the connecting pins between them and the top tower section, lower the transition beam and mounting device down to ground.

4.25.16 Dismantling the climbing unit and tower section

- 1) Lift and hold the climbing unit, remove the connecting pins between it and the top tower section, lower it down to ground.
- 2) Dismantle the rest tower section and base tower section one by one.

4.25.17 Dismantling the central ballasts, chassis, travelling bogies

For the stationary/travelling chassis tower crane, dismantle the central ballasts one by one, disassemble the chassis in opposite order of Section 4.21. For the travelling chassis tower crane, dismantle the travelling bogies then.



- *The dismantled crane needs to be checked and maintained by technical personnel and trained maintenance personnel.*
- *Check main stressed structural members for metal fatigue; weld fissure, structural deformation, etc. Check tower crane parts for damage or collision injury.*
- *After completion of checks, repair the defects found and defects potential. Carry out rust removing and painting.*

5 OPERATION AND CONTROL

5.1 Driving safety requirements for tower crane

Please read the requirements in **Chapter 2 <SAFETY INSTRUCTION>** of this manual carefully.



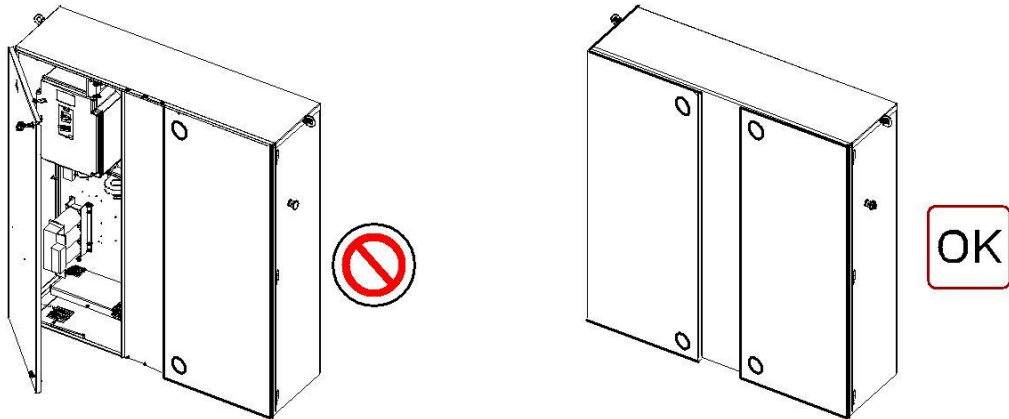
The driver needs to read the manual before operating.

5.2 Attention for operation

- Operate the crane only all the safety devices are in good condition.
- Adjust the limiters according to the instruction handbook strictly.
- Sufficient lighting shall be provided to the working area for night working.
- Keep all platforms, ladders, rails, and railings from dirt.
- No unauthorized persons are allowed climb the crane!
- People who have been approved can climb up or down the tower crane after the tower operators stopping the crane!
- Test run before working, work after confirming the tower crane is in good condition.
- Whistle before action every time.
- Don't lay the hook onto the ground in order to avoid disordering the ropes.
- Operators should give some relevant warning signals on occasion.
- Stop working immediately once some defects harming tower crane operation safety are found.
- The tower crane driver should observe the state of the tower crane in the cabin during the climbing and descending process, when the tower crane is abnormal, the driver should handle the problem in time.
- When the tower crane rises and falls, no one is allowed stand under the tower crane without permission

5.3 Specific safety instructions

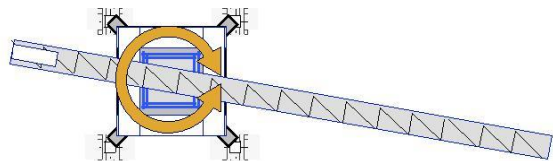
When the crane is in service, all the control panel doors must be locked.



The crane driver must position the jib in the direction of the wind before any weathervane operation.



At each operation in the slewing area of the slewing crane part, the crane driver must be extremely vigilant (crushing hazard).

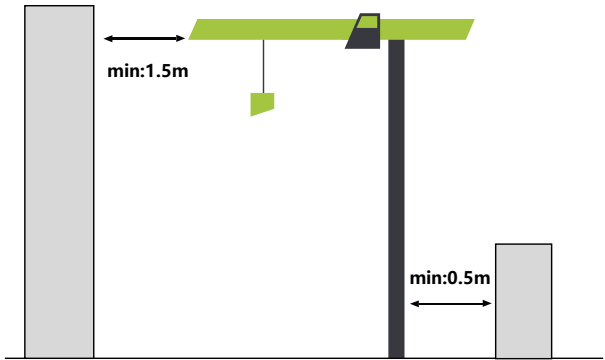


It is compulsory to put the control unit out of service as soon as the crane driver lays it down or no longer controls the crane.

5.4 Preparation before operation

5.4.1 Inspection before operation

Table 5-1 Check list before operation

Item	Content
Common	Check the wind speed, the maximum allowed wind speed is 20 m/s when the tower crane is working; The maximum allowable wind speed is 14 m/s when the tower is erected and climbing up; Check the environment temperature, the normal working temperature range of the tower crane is: -20°C ~ +40°C; Check the working voltage of the tower crane; Check the safe distance of the cable from the largest rotating part of the tower crane; Check the distance between the tower crane and surrounding buildings.  Make sure that all central ballasts and counter ballasts are of the correct weight, quantity, and proper placement; Check whether the tower crane foundation is in good condition; Make sure all gears and bearings, etc. are well lubricated, such as slewing rings; When in lightning area, customers need to equip their own lightning protection devices to ensure that lightning protection devices are installed according to local requirements and that the tower crane is properly grounded.
Base	Check whether the connecting bolts of the outriggers and the base tower section are correctly installed and tightened or whether the anchor bolts are tightened; Check the cable routing to prevent damage.
Mast	Check whether the high-strength bolts between the tower sections are installed correctly and whether the pre-tightening torque meets the requirements;

Item	Content
	Check whether the ladder, platform, etc. are firmly connected.
Climbing equipment	Check the connection to the transition section; Check whether the rollers and the support bar are flexible and reliable, and whether the connection is firm; Check whether the ladder, platform, etc. are firmly connected.
Transition section	Check whether the ladder, platform, etc. are firmly connected; Check whether the connection with the standard section, climbing equipment and slewing support is firm.
Slewing unit	Check the tightness of the bolts connected to the slewing bearing; Check whether the mounting device trolley is clear of obstruction; Check cable routing; Check whether the ladder, platform, etc. are firmly connected; Check whether the connecting pins between the turntable and slewing tower, slewing support and the tower section are correctly installed.
Cabin	Check the connection of the cabin; Check internal circuit connections; It is strictly forbidden to store lubricating oil, oil cotton yarn and other flammable items in the cabin.
Jib	Check if the connecting pins, baffles, washers and cotter are correct installation of pins everywhere; Check the fastening of platforms, ladders, passages, and gondolas; Check the winding and tightening of the hoisting wire rope.
Counter jib	Check the correctness of the installation of connecting pins, shaft end shields and pivots; Check the installation of the counter jib railing and the walkway to ensure that the walkway is free of debris; The hoisting wire rope roller can rotate freely.
Hook	Check the hook for defects that affect its use; Check whether the specifications and models of the hoisting wire rope meet the requirements; Check wear and tear of the wire ropes and pulleys.
Mechanism	Check the installation and operation of each mechanism; Adjust the brake clearance of each mechanism right position; Check the trolley mechanism. When the trolley reaches the max. and min. radius, the wire rope on the drum should have at least 3 safety rings; Check that the wire rope is wound correctly on the drum;

Item	Content
	Check whether the compression of each wire rope head is loose.
Safety equipment	Check whether each safety protection device is adjusted according to the requirements of this operation manual; Check that all safety devices are reliable; The limiter must be re-adjusted every time after climbing, the jib length is changed, or after a period of use.
Electronic control system	The insulation resistance of the main loop control loop to ground should not be less than 0.5 MΩ; The grounding resistance of the mast to the ground should not be greater than 4Ω.
Lubricating	Check lubrication according to Maintenance Manual.

5.4.2 Check after power on

After every power-on, before starting the tower crane, the operator must check the following in the empty hook state:

- Whether each switch button (especially the "emergency stop button"), operating handle, brake, travel limit and protection switch work normally;
- Safety monitoring system in the cabin is firmly installed, and whether the communication cable is connected reliably;
- Whether the limit protection switches are well adjusted;
- After each limit protection switch is activated, whether the electronic control system can perform the corresponding protection function;
- If any abnormality is found, it should be stopped immediately for maintenance;
- The tower crane shall not be put into operation until the failure or potential safety hazard has been eliminated.



Each mechanism of this series of tower cranes uses variable frequency speed drive, and each frequency converter will generate a certain high-frequency leakage current during operation, which is determined by the inherent output characteristics of the frequency converter. The leakage current of each frequency converter may be greater than 100mA. In order to ensure the normal use of the tower crane, the B-type (delayed) leakage protection circuit breaker in accordance with IEC 60755 and VDE 0664-100 standards should be selected on the power supply of the construction site, and Please ensure that all parts of the tower crane are reliably grounded.

5.4.3 Tower crane startup

After confirming that the inspection and preparation are done before starting, and the main power switch QF is closed, press the green start button of the linkage platform to start the tower crane

directly.

The start button is located on the right linkage table panel, it is a dual function button, namely: start and electric whistle function. When the main power switch QF of the hoisting and power cabinet is closed, the left and right linkage table handles are in the zero position, the grid voltage phase sequence is normal, and the components of the startup circuit are running normally, press this button to start the system.



- *When the system starts, the green "start" indicator on the left linkage stage is on, indicating that the electric control system is successfully powered on.*
- *The driver will hear the buzzer beep 5 times within 2 seconds, and at the same time the alarm light on the right linkage platform flashes 5 times, indicating that the alarm device is normal.*

When the electronic control system is successfully started, the operation of each mechanism can be carried out. When using the operating handle, the self-reset button on the top of the handle should be pressed down to release the self-locking before pushing.

When the handle is pushed, the buzzer in the linkage station will emit a short "beep" every time it enters a gear.

When the sound and light alarm signal occurs, the electronic control system will automatically limit the relevant movement (such as prohibiting the movement of a certain mechanism, slowing down the movement in a certain direction, etc.).



The requirements for the working environment are relatively high. Such as poor quality of power supply (low or high voltage, unbalanced three-phase), power supply fluctuation, high ambient temperature, frequency converter overload, motor overload, frequency converter overheating, output phase loss, output side ground fault, etc. Frequency converter stops.

In most cases, this does not mean that the frequency converter has been damaged, but the built-in automatic fault protection function of the frequency converter comes into play and enters a protective shutdown state. Under normal circumstances, after the power supply returns to the normal range or the corresponding fault is eliminated, press the "ENTER" key of the digital operator on the frequency converter panel, and the frequency converter can return to the running state; or restart the power supply after a few minutes. control system, the frequency converter can automatically reset and enter the running state.

If the frequency converter stops frequently, first judge, if it is caused by the poor quality of the power supply, stop working temporarily, and start the operation after the power supply is normal; If it is caused by other faults or unknown reasons, you should suspend use, and promptly notify our company to send personnel to deal with it. Please do not repair or modify parameters by yourself, so as to avoid further damage.



All internal parameters of the frequency converter are not allowed to be changed by non-manufacturer personnel without the permission of the manufacturer's professionals (such as designers and professional after-sales service personnel).

5.4.4 Safety device calibration

Tower crane safety protection devices mainly include: moment limiter, hoisting limiter, height limiter, trolley limiter, slewing limiter and anemograph.



Starting the tower crane for the first time, the safety protection device of the tower crane needs to be calibrated, and the tower crane can be used normally only after the safety protection device of the tower crane is confirmed to be effective.

Detailed calibration methods, see **Section 4.20**.

5.4.5 Tower crane operation

5.4.5.1 Hoisting and lowering operation

The hoisting operation is controlled by the handle on the right linkage table, pull inwards when it goes up, and push it outwards when it goes down. There are five gears for hoisting and lowering, corresponding to five speeds, and must be switched gear by gear when changing gears.



In some occasions, the driver wants to hoist the hook to the bottom of the trolley, but it cannot be realized due to the limiter. At this time, operator can press the "Bypass" button on the left linkage table with his left hand, and right hand operate the handle on the right linkage table to hoist the hook to the limit position. The operator should pay attention to the position of the hook to avoid collision.

- 1) In addition to the above basic operations, it also has the following customization functions:
Micro-speed and jog functions: press the micro-speed button on the right linkage table at any time to turn on the micro-speed function (the speed of gears 1 to 5 is reduced to about half of the normal operating speed, subject to the actual micro-speed operating speed); Press the micro-speed button, and then operate and keep the button pressed, after the gear is reset to zero, activate the function of jogging without closing the brake. If there is no hoisting action within the set time (the default setting is 5 seconds), the brake will be braked, exit the jog mode; If you release the jog button within 5 seconds, the brake will immediately hold the brake and exit the jog without closing mode.
- 2) Speed with load function: When the weight load is over 50%, it is allowed to turn the handle to the 3rd gear of the base frequency. At this time, the frequency converter will automatically adjust to the maximum allowable speed according to the load weight, which can improve the hoisting efficiency.

- 3) Anti-slip hook function: When the frequency conversion hoisting system is not in operation, it still detects the state of the hoisting mechanism at all times. To maintain the relative height of the hoisting weight, prevent the hoisting weight from falling, and issue an alarm prompt, the up and down movement of the main hook is limited to the 2nd gear of the fundamental frequency, and the inward and outward movement of the trolley is limited to the 2nd gear. Left and right movement of the arm is limited to 2nd gear.



When the anti-slip hook function is on, the display shows "the tower crane has entered the hovering anti-slip hook state", and the system automatically enters the hovering state. At this time, the personnel under the tower must be immediately notified to evacuate the dangerous area, At the safety situation, lower the hoisting weight to a suitable place on the ground, and then notify the relevant professionals to check the cause of the failure. When the protection function is activated, do not press the emergency stop switch or cut off the power supply of the control system and the hoisting frequency converter, otherwise the anti-slip hook function will fail, and even emergency hazards will occur, which is very dangerous!

5.4.5.2 Trolley operation

The trolley operation method is as follows: the trolley operation is controlled by the handle on the left linkage table, when the radius is trolleyed outward, the handle is pushed forward vertically, and when the radius is inward, the handle is pulled vertically inward. There are five gears for outward and inward trolley. Corresponds to five speeds from low to high.



In some occasions, the driver wants to drive the trolley to the base of the arm, but it cannot be realized due to the limiter. The handle on the linkage table can drive the trolley to the limit position. The operator should pay attention to the position of the trolley to avoid collision.

- 1) In addition to the above basic operations, it also has the following customization functions:
Trolley anti-vehicle function: During operation, shift the gear in the opposite direction of the operation, and the anti-vehicle operation can be performed to enhance the trolley deceleration force.
- 2) Trolley reduce-sway function: see **Section 5.4.5.4** for details.

5.4.5.3 Slewing operation

The slewing operation is controlled by the handle of the left linkage table. When turning left, turn the handle horizontally to the left, and when turning right, turn the handle horizontally to the right. The left and right directions of the handle are divided into five gears, corresponding to five rotation speeds from low to high. Gear changes also require gear-to-gear switching. During operation, press the jog button on the side of the left linkage table handle to speed up the rotation start speed.

In addition to the above basic operations, it also has the following customization functions:

- 1) Rotation anti-vehicle function: gear to the opposite direction of operation, can carry out anti-travel operation to enhance the slewing deceleration force.
- 2) Slewing reduce-sway function: see **Section 5.4.5.4** for details.



- Due to the long jib length, the inertia is high and the slewing operation must be smooth. When accelerating, the handle must be pulled gradually, and when decelerating, it must also be gradually withdrawn;
- It is strictly forbidden to use the brake switch when the jib is not stopped;
- In use, the following phenomena sometimes occur:
It is difficult to start the slewing, and the start time is long;
The tower crane shakes greatly when it turns to stop;
The slewing speed is too fast or too slow;
After working for a period of time, the rotary motor heats up seriously;
The slewing brake fails to open;
At this time, you should first check the power supply and the slewing frequency converter. If it is normal, please notify our company to send personnel for maintenance.

5.4.5.4 Trolley, slewing reduce-sway function description

Reduce-sway function is built in a special frequency converter, which is a set of control programs specially developed for tower crane applications. In some workplaces where the smooth operation of the hoisting weight is required, this function can be turned on to realize the reduce-sway of the trolley and slewing mechanism, and the operator can effectively eliminate the motion of hoisting weight without the need for the operator to perform complicated operations such as following the hook. The reduce-sway function improves the safety of the operation and reduces the work intensity and skill requirements of the tower and cable workers.

This feature can be turned on or off through an on-screen option. If the reduce-sway function is not turned on, the tower crane's trolley and slewing will run in the normal mode.

Use of the reduce-sway function:

- Turn on trolley or slewing reduce-sway on the display screen, and set the length of the hoist (the distance from the hook to the center of gravity of the hoist) according to the actual situation. The reduce-sway function of trolley and slewing can be turned on or off respectively;
- After hanging the hoist, hoisting the heavy object to the required height, and keeping the hoisting weight basically in a static state, you can operate the handle to perform trolley or slewing motion;
- In the reduce-sway mode, the anti-vehicle operation can also be performed to enhance the deceleration;
- During the operation of the mechanism, if the deceleration limit signal is triggered, the control system will immediately exit the reduce-sway mode and enter the normal operation mode to

avoid the overtravel movement of the mechanism;

- If you need to exit the reduce-sway mode temporarily (such as jogging into position, etc.), please press the button on the side of the handle of the left linkage table, the system will immediately exit the reduce-sway mode and enter the normal operation mode, and the mechanism stops running for a period of time. After a period of time, you can return to the reduce-sway mode;
- Reduce-sway can be turned off via an on-screen option.



- Speed curve will be automatically changed according to the mathematical model of reduce-sway during trolley or slewing operation. When the operator starts and stops the trolley or slewing mechanism, the acceleration and deceleration rhythm will change, and the acceleration and deceleration distance will be extended to a certain extent. When using the reduce-sway function, the operator should try the operation several times in advance to adapt to the running characteristics of this mode. If you can't adapt to the operating habits, you can turn off the reduce-sway function on the screen.
- In outdoor applications, the effect of wind may affect the effect of reduce-sway function.
- Please set the length of the hoist correctly (that is, the distance from the hook to the center of gravity of the hoist) according to the actual situation.
- It is necessary to ensure that the communication of the control system is normal.
- The pendulum length data sent to the trolley and slewing frequency converters must be accurate, and the calibration pendulum length detection system needs to be adjusted correctly in advance.
- When the pendulum length exceeds a certain length (usually 60 meters by default), the system automatically turns off the anti-slewing function.

5.4.5.5 Travelling operation (optional)

The travelling operation is controlled by the handle on the right linkage stage. Pull the handle to the left to move the bogie forward, and turn the handle to the right to move the bogie back. The left and right directions of the handle are divided into two gears, corresponding to two travelling speeds from low to high. When starting, you should first pull the handle from the middle to the low gear, and then pull it to the high gear; when stopping, you should first return to the low gear from the high gear, and then return to the stop gear.



Except in emergencies, it is strictly forbidden to directly return to the stop gear from the high gear, otherwise it will have a huge impact.

5.4.5.6 Tower crane power off

Each use of the tower crane, the hook should be raised to the top, the trolley should be moved to the base of the jib, the "BYPASS" button and the "slewing brake" button should be pressed, weathervane should be turned on, and the emergency stop button should be pressed to cut off the power supply.

5.4.6 Alarm

When the driver uses the linkage console handle to operate, he will hear a "beep" feedback every time he shifts gears. When operating the electronic control system, the driver should be familiar with the following various alarm signals provided by the system:

5.4.6.1 Moment alarm signal

1) Over moment signal

When the lifting moment exceeds 103% of the maximum allowable value, the electronic control system will respond as follows:



- Red on the linkage table The warning light flashes;
- The buzzer in the linkage station emits four continuous beeps of "di di di di".
- Upward movement of the main hook is inhibited, and downward movement is limited to first gear.
- Outward movement of the trolley is inhibited, and inward movement is limited to first gear.
- Left and right slewing motion of the jib is limited to first gear.
- Release method: run down or inward to reduce the weight.

2) Moment warning signal

When the lifting moment exceeds 90% of the maximum allowable value, the electronic control system will respond as follows:



- Yellow icon on the linkage table flashes warning light;
- The buzzer of the linkage station emits two continuous beeps of "Di Di";

- The up and down movement of the main hook is limited to the fundamental frequency gear, which is generally the third gear;
- Outward movement of the trolley is limited to second gear, and inward movement is not restricted.
- Release method: inward slewing

3) Torque warning signal

When the lifting moment exceeds 80% of the maximum allowable value, the electronic control system will respond as follows:

- Yellow icon on the linkage table  flashes warning light;
- The up and down movement of the main hook is limited to the fundamental frequency gear, which is generally the third gear;
- Outward movement of the trolley is limited to second gear, and inward movement is not restricted;
- Release method: inward slewing.

5.4.6.2 Lifting weight alarm signal

1) Overweight Signal

When the lifting weight exceeds 105% of the maximum allowable value, the electronic control system will respond as follows:

- Red icon on the linkage table  flashes warning light;
- The buzzer in the linkage station emits three continuous beeps of "di di di";
- Upward movement of the main hook is inhibited, and downward movement is limited to first gear;
- Outward movement of the trolley is inhibited, and inward movement is limited to first gear;
- Left and right slewing motion of the boom is limited to the second gear.
- Release method: run down to reduce the weight.

2) Overweight warning signs

When the lifting weight exceeds 90% of the maximum allowable value, the electronic control system will respond as follows:

- Yellow icon on the linkage table  flashes warning light;
- The buzzer in the linkage station emits a continuous "beep" alarm sound;
- The up and down movement of the main hook is limited to the fundamental frequency gear, which is generally the third gear;
- Outward and inward movement of the trolley is limited to the fundamental frequency gear;
- Release method: reduce the lifting weight.

3) Overweight warning signs

When the lifting weight exceeds 50% of the maximum allowable value, the electronic control system will respond as follows:

- Yellow icon on the linkage table  flashes warning light;
- The up and down movement of the main hook is limited to the fundamental frequency gear, which is generally the third gear. (Note: The hoisting speed limit is canceled when the hoisting speed with load function is enabled.)
- The outward and inward movement of the trolley is limited to the fundamental frequency gear plus one gear.
- Release method: reduce the lifting weight.

4) Overweight warning signs

When the lifting weight exceeds 25% of the maximum allowable value, the electronic control system will react as follows:

- The up and down movement of the main hook is limited to the fundamental frequency gear plus one gear, generally four gears. (Note: The hoisting speed limit is canceled when the hoisting speed with load function is enabled.)
- Release method: reduce the lifting weight.

5.4.6.3 Lifting alarm signal

1) Upward stop limit signal

When the lifting hook has reached the maximum allowable value and the upper stop limit is triggered, the electronic control system will respond as follows:

- The upward movement of the main hook is prohibited;
- Release method: lower the main hook.
- Releasing the limit method under specific working conditions:

When the trolley enters the inner reduction area, press the "Bypass" button; the speed of lifting and upward movement is limited to the first gear. After the working condition is completed, lower the main hook below the upper reduction limit to release the speed limit.

2) Upward deceleration limit signal

When the hook height is close to a certain distance from the upward deceleration limit point and the upward deceleration limit signals are triggered, the electronic control system will respond as follows:

- The upward movement of the main hook is forcibly limited to the first gear.

3) Downward stop limit signal

When the height of the hook is close to the ground and the downward stop limit is triggered, the electronic control system will respond as follows:

- The downward movement of the hook is prohibited;
- Release method: raise the main hook.
- Releasing the limit method under specific working conditions:

Press the "Bypass" button; the downward movement speed is limited to 1st gear. After the working is completed, lift the main hook above the downward limit release the speed limit.

4) Downward deceleration limit signal

When downward, when the height of the hook is close to the downward deceleration limit point and triggers the downward deceleration limit signal, the electronic control system will respond as follows:

- The downward movement of the main hook is forcibly limited to the first gear.

5.4.6.4 Radius alarm signal

1) Trolley outward stop signal

When the trolley moves outward, when the trolley has reached the jib end and the trolley outward stop limit signal is triggered, the electronic control system will respond as follows:

- Outward movement of the trolley is prohibited.

2) Trolley outward deceleration signal

When the trolley moves outward, when the trolley is close to a certain distance from the jib end and triggers the trolley outward deceleration limit, the electronic control system will respond as follows:

- Outward movement of the trolley is forcibly limited to first gear.

3) Trolley inwards stops limit signal

When the trolley is going inside, when the trolley has reached the jib foot and the trolley inwards limit is triggered, the electronic control system will respond as follows:

- Inward movement of the trolley is prohibited.
- Release method under specific conditions:

Press the "Bypass" button; the trolley inward movement speed is limited to 1st gear. After the working is completed, the speed limit can be lifted by moving the trolley outwards beyond the trolley inwards deceleration limit.

4) Trolley inwards deceleration signal

When the trolley is going inside, when the trolley is close to a certain distance from the jib foot and triggers the inner reduction limit, the electronic control system will respond as follows:

- The inward movement of the trolley is forcibly limited to first gear.

5.4.6.5 Slewing alarm signal

1) Slewing left stop limit signal

When the jib rotates to the left more than one and a half circles and the slewing left stop limit is triggered, the electronic control system will respond as follows:

- Left rotation movement of the jib is prohibited.

2) Slewing left deceleration limit signal

When the jib rotates to the left for more than one and a half circles and triggers the slewing left deceleration limit, the electronic control system will respond as follows:

- The rotation movement of the jib to the left is limited to first gear.

3) Slewing right stop limit signal

When the jib rotates to the right for more than one and a half circles and triggers the slewing right stop limit, the electronic control system will respond as follows:

- Right rotation movement of the jib is prohibited.

4) Slewing right deceleration limit signal

When the jib rotates to the right for more than one and a half circles and triggers the slewing right deceleration limit, the electronic control system will respond as follows:

- Right rotation movement of the jib is limited to first gear.

5.4.7 Other alarms

1) Overvoltage and undervoltage protection alarm

When the external power supply is under or over-voltage, the indicator HU is on (the indicator is on the driving box);

When the power supply voltage is higher or lower than the local standard requirements, the power circuit is disconnected. When the red LED (F1 light) is on, the over-voltage alarm stops; when the red LED (F2 light) is on, the under-voltage alarm stops;

Take China as an example, when the power supply voltage is greater than 110% of the rated voltage or lower than 90% of the rated voltage, the power supply circuit will be automatically cut off, and the overvoltage and undervoltage indicator lights on the driving box will be on. If the voltmeter on the drive box is in a low voltage or high voltage state for a long time, please do not start and work the tower crane, so as to avoid mechanical shock and possible danger when the power circuit is cut off and shutdown, and may also damage the motor and electrical element.

2) Phase sequence protection alarm

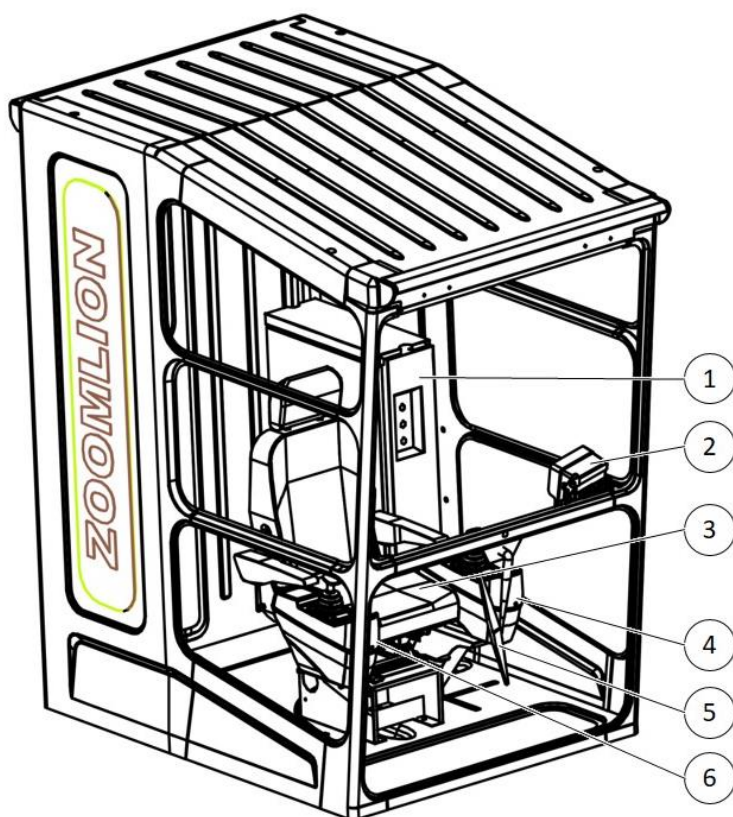
When the phase sequence of the external power supply is incorrect or lacks phase, the yellow LED light on the phase sequence relay is off, the power circuit is disconnected, and the start indicator light is off (the indicator light is on the linkage table).

5.5 Instruction of control unit

5.5.1 Overview

The cabin is the control center of the tower crane, the main layout is shown

Fig. 5-1 Cabin:



(1) Driving box

(3) Seat

(5) Wiper

(2) Monitor

(4) Left linkage station

(6) Right linkage station

Fig. 5-1 Cabin

5.5.2 Control panel, control instrument, man-machine interface description

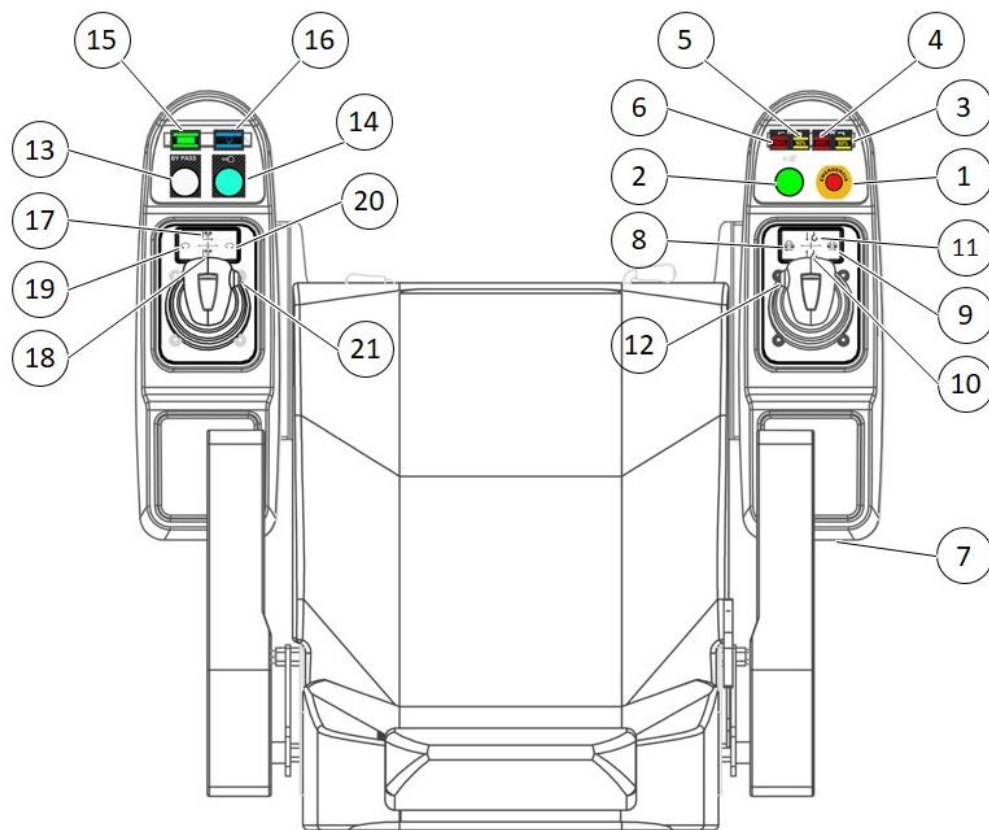
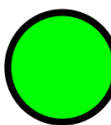
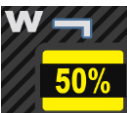
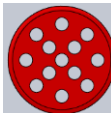


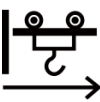
Fig. 5-2 Linkage console

5.5.3 How to operate

The linkage console in the driver's cab is the console of the tower crane, which is installed on the left and right sides of the driver's cab seat (See the attached table for the explanation of the keys).

No.	Icon	Name	Function Description
1		Emergency stop button	In case of emergency, cut off the power and control power of the tower crane. Not to be used in non-emergency situations After the button is pressed, it needs to be rotated to release.
2		Electric whistle/start button (green)	Electric whistle control button. The power-on start button of the whole machine.
3		Over 50% rated lifting capacity warning light (yellow)	When the hoisting weight exceeds 50% of the rated lifting weight, the warning light will be on, and the buzzer will sound an alarm (see Article 7).
4		Over 105% rated lifting capacity warning light (red)	When the hoisting weight exceeds 105% of the rated lifting weight, the alarm light will be on, and the buzzer will sound an alarm (see Article 7).
5		Over 90% rated moment warning light (yellow)	When the load moment exceeds 90% of the rated moment, the warning light will be on, and the buzzer will sound an alarm (see Article 7).
6		Over 100% rated moment warning light (red)	When the load moment exceeds 103% of the rated moment, the alarm light will be on, and the buzzer will sound an alarm (see Article 7).
7		Buzzer	Self-test beeps 5 times at startup 5 seconds every 15 seconds when there is no GPS signal 4 beeps every 0.5 seconds when the moment is exceeded 2 beeps every 0.5 seconds during moment warning 3 beeps every 0.5 seconds when overweight 1 sound every 0.5 seconds during weight warning 1 sound when the operating gear changes 1 sound when the weathervane is released The linkage table stick point fault or PLC fault buzzer keeps ringing

No.	Icon	Name	Function Description
8		Walking to the left operation direction indication	Effective with walking mechanism When the right linkage table handle is operated in this direction, the walking will run to the left.
9		Walking right operation direction indication	Effective with walking mechanism When the right linkage table handle is operated in this direction, the walking will run to the right.
10		Hook up operation direction indication	When the handle of the right linkage table is operated in this direction, the hook will run upwards.
11		Hook lowering operation instructions	When the handle of the right linkage table is operated in this direction, the hook runs downward.
12		Right linkage platform jog button (green)	Lift function switch: Press this switch to activate the hoisting micro-speed function. After the hoisting operation is performed and the gear position returns to zero, the jog does not close the brake function is activated; until the switch is released to return to the zero position, the hoisting brake will hold the brake after 5 seconds, and the micro-speed will be activated. function release.
13		Bypass button	For details, please refer to the relevant chapters of "System Prompts and Alarm Signals"
14		Slewing brake button	Slewing brake button switch, see "How to use slewing brake and weathervane release" for details.
15		Start light (green)	After the whole machine is powered on, the indicator light is on.
16		Rotary weathervane release indicator (blue)	After the weathervane is released, the indicator light is on.
17		Inward trolley operation direction indication	When the left linkage table handle is operated in this direction, the trolley mechanism runs inward.

No.	Icon	Name	Function Description
18		Outward trolley operation direction indication	When the left linkage table handle is operated in this direction, the trolley mechanism runs outward.
19		Rotate left operation direction indicator	When the left linkage table handle is operated in this direction, the slewing mechanism rotates to the left.
20		Rotate right operation direction indicator	When the left linkage table handle is operated in this direction, the slewing mechanism rotates to the right.
21		Left linkage table jog button (green)	Rotary jog function switch: Pressing this switch will activate the jog function of the rotation; until the handle returns to the zero position, the jog function is released.

5.5.4 Driving box

The drive box is installed in the driver's cabin. It is the core part of the control system. Components such as the controller and the intermediate relay of the safety device are installed in the driving box.

- 1) The main switch devices and their functions in the cabin are shown in the table below:

Table 5-2 Driving box switch devices

No.	Device code	Device function	Remark
1	QF6	24V power protection breaker	If this circuit breaker is disconnected, the tower crane will not be able to work.
2	QFB	Short-circuit protection for wipers, water sprayers and automatic lubricating oil pump.	Short-circuit protection for wipers, water sprayers and automatic lubricating oil pump.
3	SPM	Mode selector switch	2 working mode options: electromechanical mode, mechanical mode. When the electronic safety device is not calibrated or fails, the mechanical mode can be turned on. At this time, only the mechanical safety device works, and the speed of hoisting, turning and trolley is limited to 4th gear.



If the switch in the above table is an air switch, the switch handle is turned up to be in the "on" state; if the switch in the above table is an electromagnetic protection circuit breaker, the switch handle is rotated clockwise until the handle is in the vertical state to be in the "on" state.

- 2) The device code and function description of the door panel of the driving cabin are shown in the following table:

Table 5-3 Cabin door components

No.	Device Diagram	Device code	Device function	Notice
1		PV	Power supply voltage indication	The normal value of the line voltage of the power supply should be: 380V±10%
2		HU	Power over and under voltage indicator	When the overvoltage and undervoltage indicators are on, do not start the tower crane, otherwise the related electrical equipment may be damaged.
3		SPP	Climbing operation switch	

5.5.5 Hoisting and power cabinet

The hoisting and power cabinet is the main part of electric control system. The main power switch, hoisting controller, heater, cooling fan are installed in it.

- The main switch devices and their functions of the cabin are shown in the table below:

Table 5-4 Main switch components of the hoisting and power cabinet

No.	Device code	Device function	Remark
1	QFHB	Hoisting brake power switch	
2	QFHC	Hoisting motor cooling fan power switch	
3	QFP	Climbing mechanism main power switch	
4	QFFE1	Main control cabin heating and cooling power supply circuit leakage protection switch	For some models, this switch is in the driving box. Subject to the actual layout.
5	QFGS	Hydraulic Clamp Control Cabinet Control Power Supply Switch	
6	QFHG	Hydraulic Clamp Control Cabinet Power Supply Switch	
7	QF1	Electric Siren Protection Switch	
8	QF2	Voltmeter Protection Switch	
9	QF3	KAU、KAP	
10	QF4	Transformer and Power Monitor Power Switch	
11	QF5	Main Circuit Control Switch	

- The device code and function description of the hoisting and power cabinet door panel are shown in the following table:

Table 5-5 Hoisting and power cabinet door components

No.	Device Diagram	Device code	Device function	Notice
1		QF	Tower crane control system main power switch	Rotate the handle clockwise, when the handle mark points to ON, the main power switch is closed; rotate counterclockwise, when the handle mark points to OFF, the main power switch is cut off.
2		SEM2	Emergency stop button	It is used to cut off the power and control power of the tower crane in an emergency. Do not use the emergency stop button to stop in non-emergency situations. Otherwise, it will have a great impact on the tower body structure, and even cause more serious safety accidents. The button is self-locking. After pressing, it needs to be rotated to release. Before starting the tower crane, please confirm that the emergency stop button is in the released state.



- Main control cabin door is only allowed to be opened when the QF handle points to OFF. Similarly, the hoisting and power cabinet door is only allowed to be closed when the QF handle points to OFF. Don't violently open and close the hoisting and power cabinet door to avoid damage related parts.
- In an emergency, the emergency stop switch must be pressed immediately;
- When the hoisting mechanism of the tower crane entering the hovering state due to the anti-slip hook function is activated, do not press the emergency stop button;
- When the driver gets off work or leaves the cab for some reason, or when the tower crane is overhauled, the emergency stop button must be pressed when all the tower crane mechanisms are in a stopped state.

- Heating, dehumidification and heat dissipation in the hoisting and power cabinet
- Heater: After the power is turned on, the temperature and humidity conditions are automatically detected, and the heater is started when the temperature is $\leq 0\text{ }^{\circ}\text{C}$ or the humidity is $\geq 80\%$.
- Cooling fan: After the power is turned on, the temperature will be automatically detected. When the temperature is $\geq 40\text{ }^{\circ}\text{C}$, the fan in the cabin will exhaust air to the outside.



- *If the working conditions of the heater or cooling fan are reached, and the cooling fan and heater do not work, please check whether the components are damaged.*
- *Working power of the heater and the cooling fan is U1, N; that is, after the power supply of the knife switch box is turned on, as long as the working conditions of the heater and the cooling fan are reached, it will start to work.*

5.5.6 Slewing and trolley cabinet

The slewing and trolley cabinet is the main part of electric control system, too. The slewing controller, luffing controller, heater, fan and other components are installed in the cabinet.

- The main switch devices and their functions of the cabin are shown in the table below:

Table 5-6 Main switch components of the slewing and trolley cabinet

No.	Device code	Device function	Remark
1	QF7	Slewing break power switch	
2	QFZ	Transformer input protection switch	
3	QFD5	Transformer output protection switch	
4	QFD6	Rectifier module output protection switch	

- Heating, dehumidification and heat dissipation in the main control cabin
- Heater: After the power is turned on, the temperature and humidity conditions are automatically detected, and the heater is started when the temperature is $\leq 0\text{ }^{\circ}\text{C}$ or the humidity is $\geq 80\%$.
- Cooling fan: After the power is turned on, the temperature will be automatically detected. When the temperature is $\geq 40\text{ }^{\circ}\text{C}$, the fan in the cabin will exhaust air to the outside.

5.5.7 Resistor cabinet

The resistor cabinet is the energy release element of the tower crane control system. Its main function is to release the residual electric energy generated by the lifting and downward movement and the braking process of each mechanism. Please operate in strict accordance with the precautions. Improper operation may cause the resistor cabinet to be burned, resulting in tower crane failure.



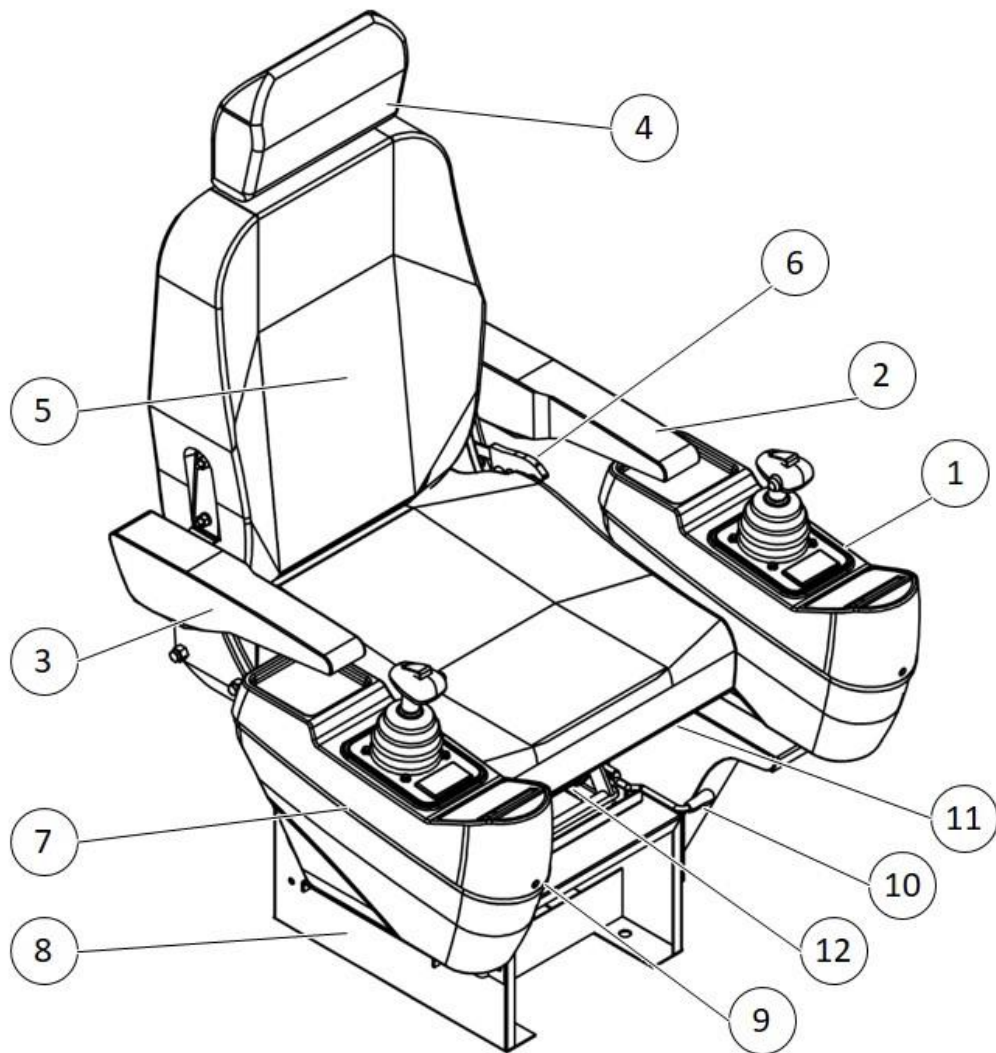
Fig. 5-3 Resistor cabinet



- *Before running the tower crane, please confirm that its wiring is correct and reliable, otherwise it may cause equipment damage;*
- *When laying cables around the mounting bracket of the resistor cabinet, make sure that the distance between the cables and the outer casing of the resistor cabinet is at least 15cm;*
- *The resistor cabinet is a heating component, please ensure that it is well ventilated and must not be blocked or covered;*
- *Do not stack debris near the resistor cabinet, otherwise it will cause a fire hazard.*
- *The surface of the resistor cabinet is hot, do not touch it, otherwise there is a danger of burns.*

5.5.8 Seat adjustment

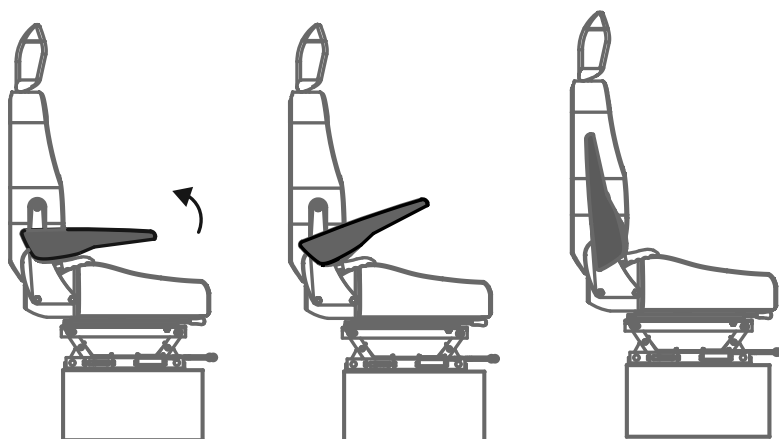
Main components of the linkage table seat are shown in the following figure:



- | | |
|------------------------------|--------------------------------|
| (1) Left linkage station | (2) Right armrest |
| (3) Left armrest | (4) Headrest |
| (5) Backrest | (6) Backrest adjustment handle |
| (7) Right linkage body | (8) Base |
| (9) Right lift unlock handle | (10) Left lift unlock handle |
| (11) Slide rail | (12) Slide rail unlock handle |

Fig. 5-4 Seat assembly

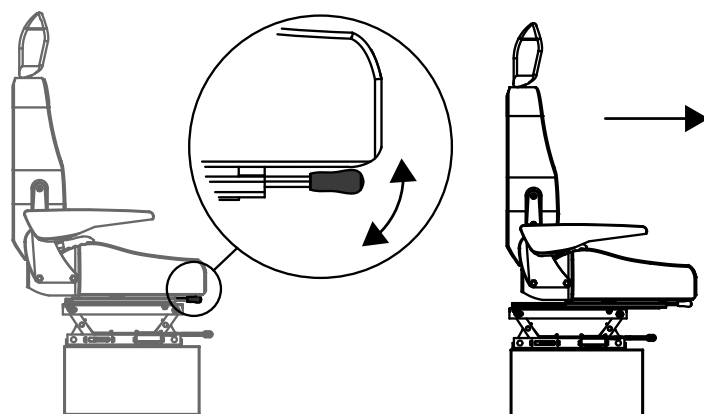
5.5.8.1 Left and right armrest adjustment



- Adjustment range: 110°

Pull the armrest up to adjust, there are three position in total, there is a clear prompt sound, the highest gear is pulled up and then pressed down to return to the original position.

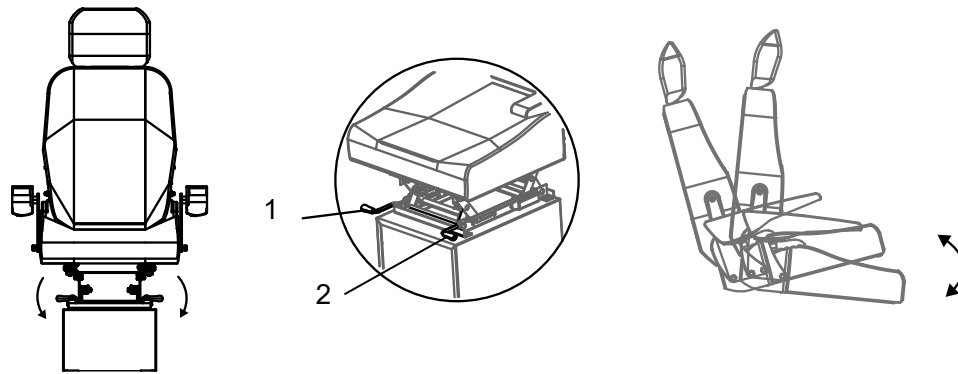
5.5.8.2 Seat slide adjustment:



- Adjustment range: front and rear 0 ~ 120mm.

Pull the unlocking lever up, move the seat forward (backward) to the desired position, release the handle, and hear a "click" sound, the slide rail can be locked.

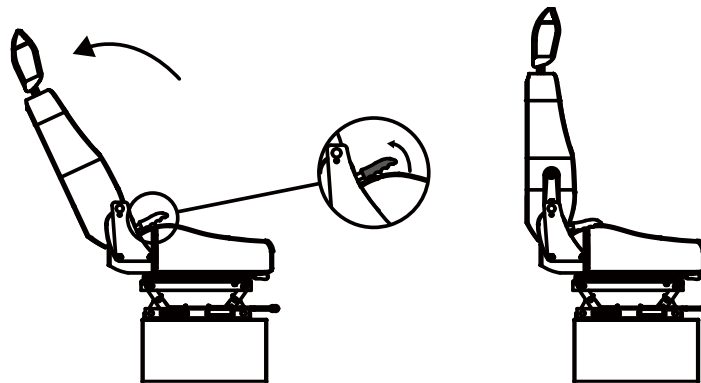
5.5.8.3 Seat up and down adjustment



- Adjustment range: There are four positions for up and down adjustment.

Press the left adjustment handle (2) to control the up and down adjustment of the entire front of the seat, and the right (1) to control the rear up and down adjustment, release the handle to complete the adjustment.

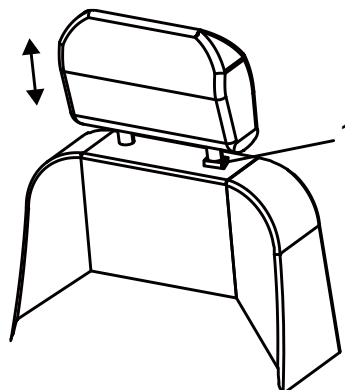
5.5.8.4 Backrest angle adjustment:



- Adjustment range: 86°~140° .

Pull the adjustment handle up, adjust the backrest to the desired position, and release the handle.

5.5.8.5 headrest adjustment



- Adjustment range: 0~80mm, a total of four positions.

Just lift it up and adjust it to a suitable position, adjust it down and press and hold the unlock button (1) and adjust it to a suitable position.

5.6 Parameter adjustment of electrical components and instruments

Voltage monitoring relay in the hoisting and power cabinet is shown in Fig. 5-5.

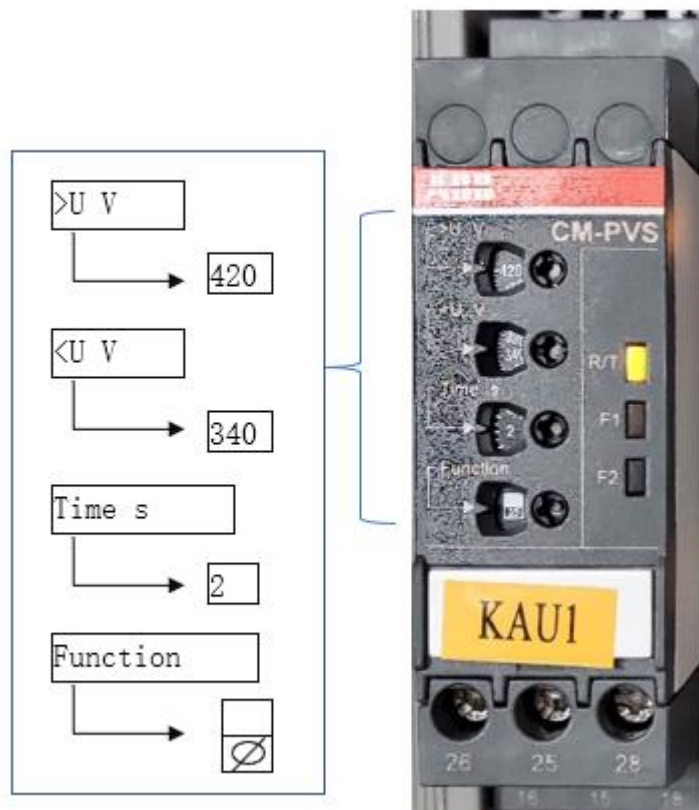


Fig. 5-5 Main control cabin voltage monitoring relay setting value

Table 5-7 Device Settings Checklist

Device code	Describe	Set value
ST	Cooling fan temperature setting value	+40°C
	Heater working temperature setting value	0°C
SRH	Heating humidity RH setting value	+80%
KAU1	Overvoltage protection value (>U):	420V
	Undervoltage protection value (<U):	340V
	Delay time (Time):	2S
	Working mode (Function):	☒ Reset delay + no phase sequence monitoring

5.7 Slewing brake use and weathervane release method

5.7.1 Overview of slewing brakes

The brake of the inverter motor with weathervane is normally closed, that is, the brake is powered off and released when it is powered on.

The slewing moment motor of tower crane is composed of main motor, brake (with weathervane). The electromagnetic brake is a power-off brake, and its structure (see Fig. 5-6).

Release when power on:

When the electromagnetic brake excitation coil (1) is supplied with the specified direct current, electromagnetic suction force is generated, the brake armature (3) is attracted, the friction disc (4) is driven, and the brake spring (2) is compressed, so that the brake disc (5) is in a released state, and the shaft can rotate freely.

Brake when power off:

When the power is off, the electromagnetic suction force disappears, and the brake spring pushes the friction disc, so that the brake disc is in the braking state, and the shaft cannot rotate freely.

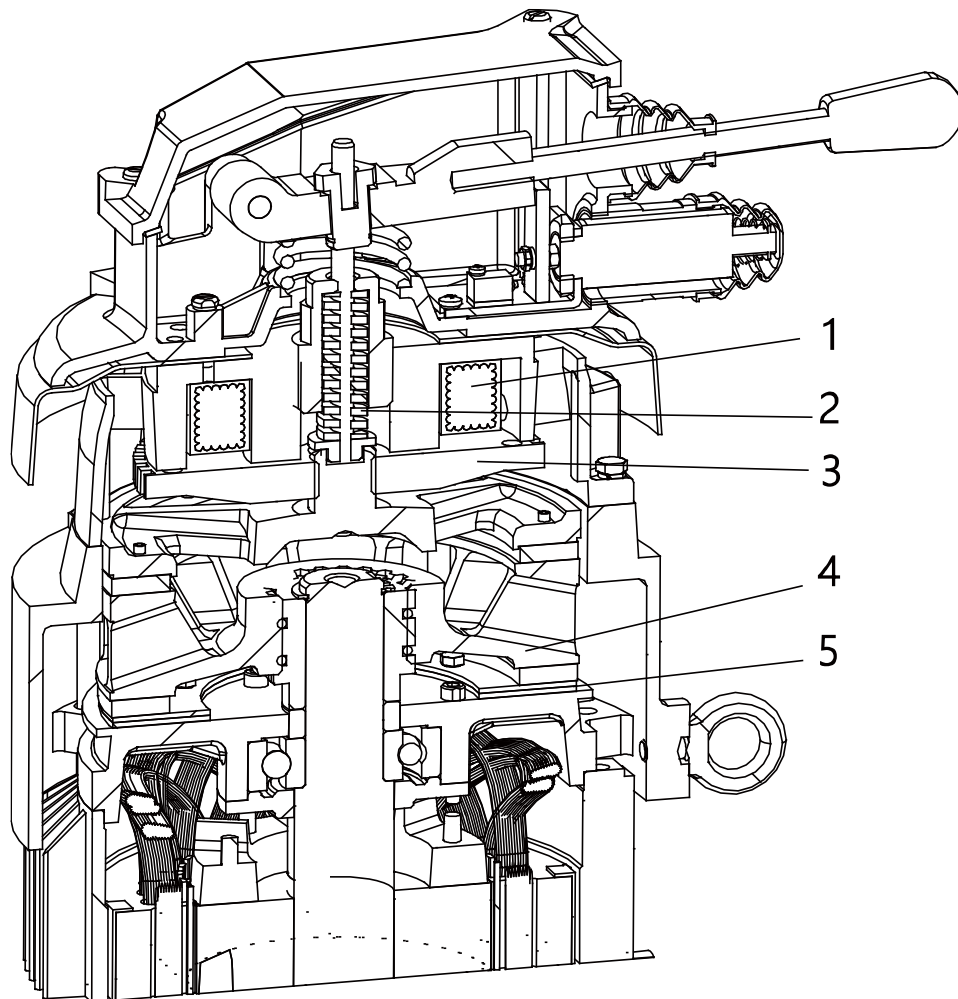


Fig. 5-6 The slewing brake

5.7.2 Slewing electromagnetic brake logic description

- 1) When the tower is slewing, the brake will be opened immediately upon electrification;
- 2) Operating handle is reset to zero, after a delay of 15 seconds, the rotary brake will automatically power off and brake;
- 3) 15-second delay after the operation handle is reset to zero, if you encounter strong winds or need to brake manually, you can press and hold the "wind flag release button" on the far right on the left linkage platform for 0.5 seconds, or you can immediately use the Slewing brake;
- 4) During the slewing operation, if you encounter an emergency and need to brake immediately, you can also press and hold the "wind flag release button" on the far right on the left linkage platform for 0.5 seconds to make the slewing brake power off and brake.
- 5) Whenever the brake goes from open to closed, that is, from power on to power off, a buzzer "beep" will be heard.



When you press and hold the weathervane release button, the slewing output will be disconnected. At this time, be sure to return the slewing handle to the zero position as soon as possible, re-operate the slewing gear, and the slewing brake will be automatically released.

5.7.3 Rotary weathervane release instructions

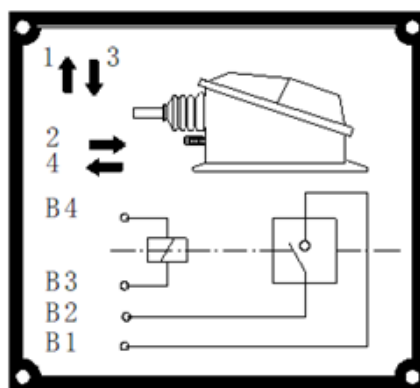
"Weathervane release button" (with light) is a button that can be used to realize both emergency braking of the slewing brake and electric release of the slewing brake.

The tower crane operator needs to set the tower crane in a free rotation state after get off work to prevent the danger of the tower falling due to strong winds.

Description: The electric weathervane is used in conjunction with the power-off brake to achieve the electric release and manual release of the electromagnetic brake. After it's released, even when the tower crane is power off, the brake is open, and the tower crane can rotate freely with the wind.

1) Rotary weathervane electric release instructions

The structure of the electric wind flag (see Fig. 5-6), when the electromagnetic brake excitation coil is first connected to the specified DC power, and then the wind flag electromagnet excitation coil is connected to the DC power, the wind flag armature is attracted, and then the direct current of electromagnetic brake excitation coil is disconnected, at this time, the armature of the weathervane supports the weathervane release lever, so that the electromagnetic brake friction disc connected to the weathervane release lever through the release screw cannot move in the direction of the brake disc, so that the brake disc is in a released state, and finally it should be immediately disconnect the DC power of the weathervane electromagnet excitation coil to achieve the function of electric release of the electromagnetic brake. (Note: The excitation coil of the electromagnet of weathervane cannot be energized for a long time, otherwise the excitation coil of the electric weathervane electromagnet will be burned.) The wiring instruction diagram of the electric weathervane is shown in Fig. 5-7.



B1, B2: Weathervane micro-move switch (keep open)

1, 3: Direction of weathervane release lever

B3, B4: Connect to coil of the electromagnet

2, 4: Direction of weathervane push handle

Fig. 5-7 The wiring instruction diagram of the electric weathervane

Condition: The slewing gear handle is reset to zero and the slewing brake is power off.

Operation: Press and hold the "Weathervane release button" and "bypass button" at the same time, hold for more than 1 second, the rotating vane will automatically release.

Logic: Press and hold the "weathervane release button" and "bypass button" for 1 second, the slewing electromagnetic brake is powered on, the weathervane electromagnetic coil is powered on after 1 second, and the slewing electromagnetic brake is powered off after 1 second, the rear weathervane solenoid is powered off after 1 second.

Success sign: After successful release, the brake on the slewing motor with brake will be heard twice "Dong", and then the light of the "weathervane release" button on the left linkage platform will turn on, indicating that the electric release is successful.



- *Electric release can only be operated 30 seconds after the slewing motor stops (or the handle returns to zero), otherwise it will cause the motor brake to work abnormally, which will affect the safety of the tower crane in serious cases;*
- *If it cannot be released successfully, please check the "Failure Analysis" below.*

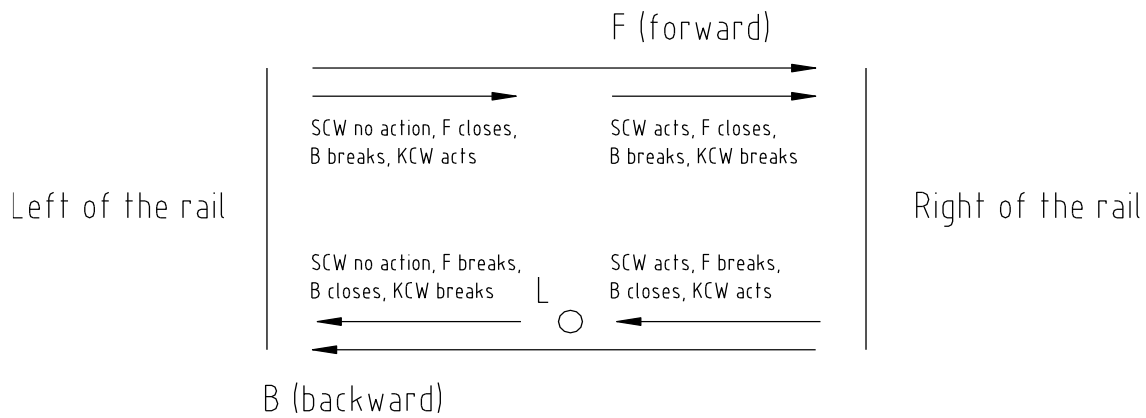
2) Instructions for manual release of rotary vane

First move the release lever to the rear of the motor, then push the weathervane push handle inward to make the weather indicator electromagnet armature support the weathervane release lever, then release the weathervane release lever, and finally release the electric weathervane push handle to achieve Manual release function. The functions of electric release and manual release of the weathervane are used to keep the motor in a released state when the tower crane is not working for a long time, so that the tower jib can rotate freely with the wind and adjust to the downwind direction, so that the windward area of the tower jib is minimized and windward resistance is minimized.

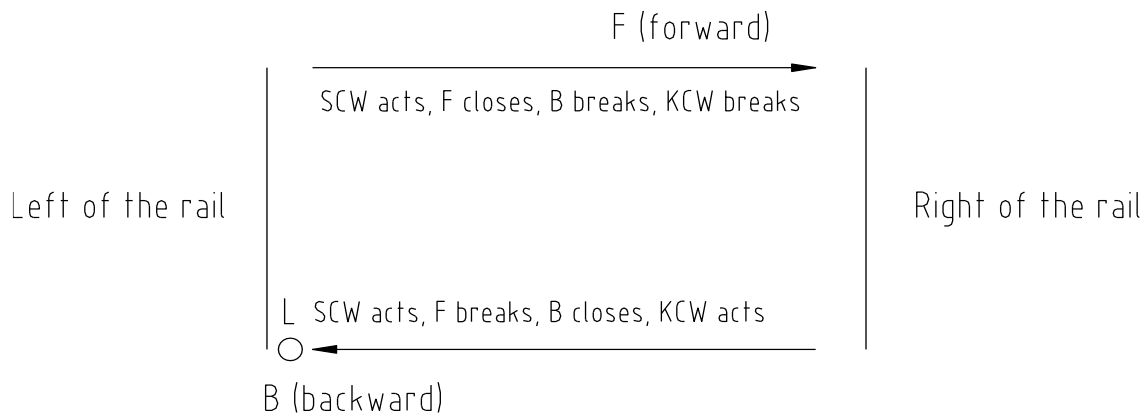
Manual release is a very reliable release method. If the electric release is unsuccessful, or the electric release is not assured, manual release can be used.

5.8 Cable drum adjustment method

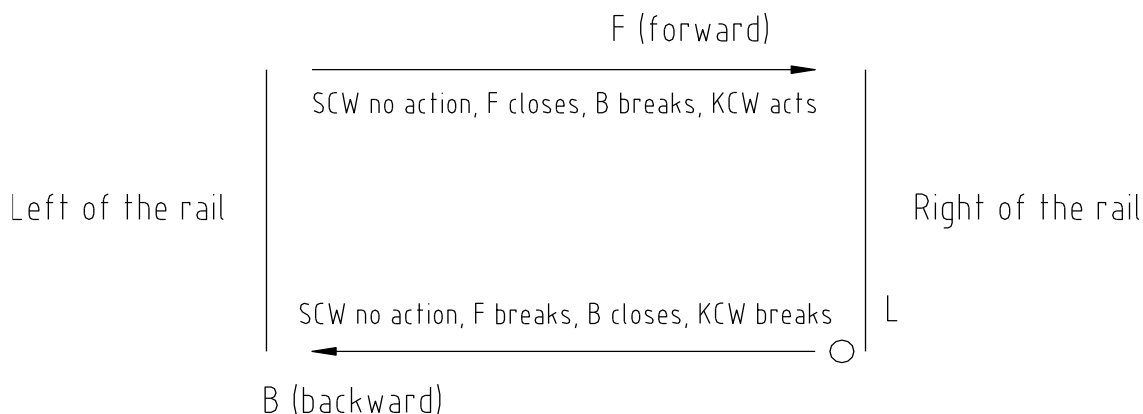
5.8.1 The cable anchorage point is in the middle of the track



5.8.2 The cable anchorage point is on the left side of the track



5.8.3 The cable anchorage point is on the right side of the track



Note:

○—— Location of cable anchorage points

L—— Limit switch position

SCW has two pairs of contacts, one is normally open and the other is normally closed

SCW action means that the normally open contact is closed and the normally closed contact is open

SCW no action means that the normally open contact is disconnected and the normally closed contact is closed

5.9 Operation after working

■ Normal operation after working

Notes for non-working state:

When the tower crane is finished construction and stops being used, the hook should be raised to a safe position to ensure that when the jib rotates freely 360°, the hook will not hang or touch any objects on the site), keep the hook in an empty state, and the weathervane brake must be released.

Set each operating handle to the zero position, cut off the main circuit breaker of cabin, close the doors and windows of the cabin, and disconnect the main switch of the power box at the bottom of the tower crane after the driver goes down to the ground.

Anti-strong typhoon safety measures and plans

■ Please refer to our company's tower crane anti-typhoon supplementary manual.

Remove the hoisting weight, lift the hook to the highest point, and drive the trolley to the minimum radius of the jib foot!

The weathervane brake must be released in the non-working state to ensure that the tower crane jib rotates freely with the wind! Make sure that there are no obstacles in the slewing range of the boom, and there are no excess objects on the hook to avoid accidents such as breaking the jib or falling tower when the strong wind comes!

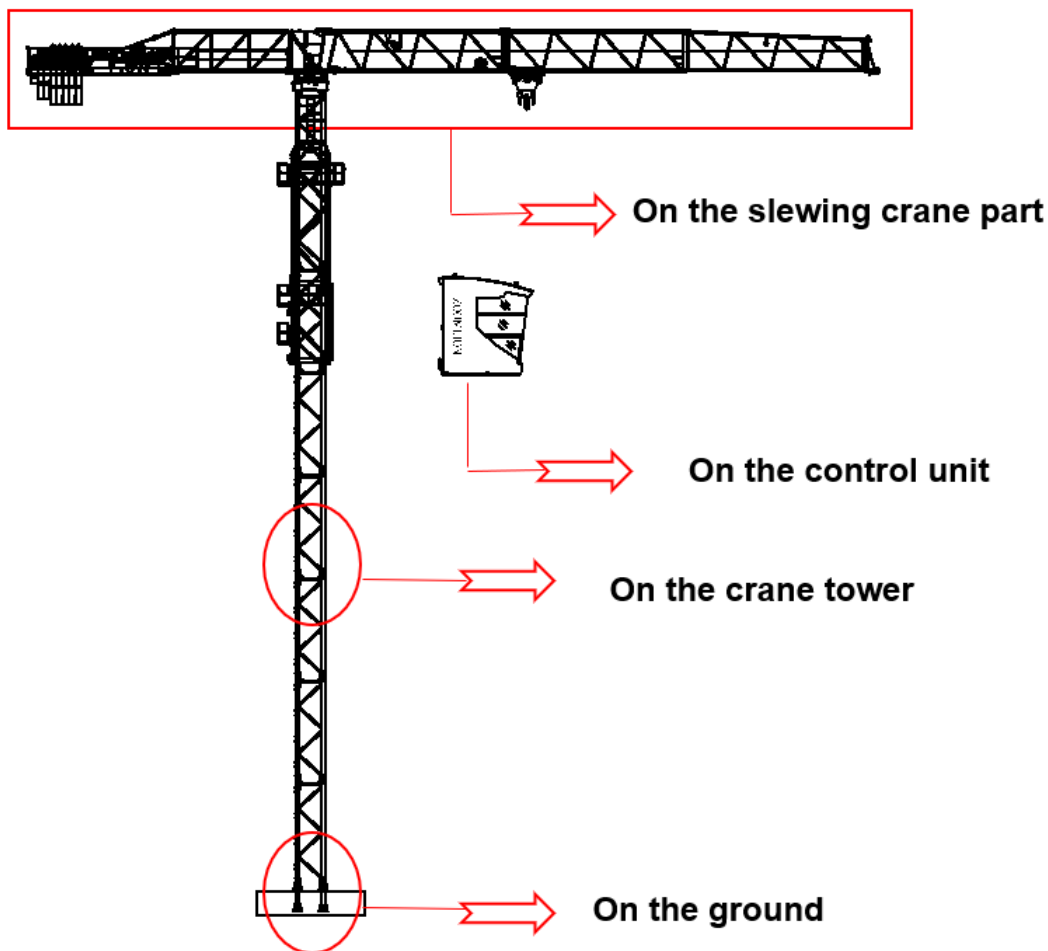
■ For the travelling tower crane, use the rail clamp to fix the tower crane on the track to prevent it from moving along the track!

5.10 Operation cautions

5.10.1 Checks to be carried out before operation

The execution of the crane erection and the safety require a certain number of operations or checks to be carried out according to the following description:

5.10.1.1 Synopsis



Before starting work, every founded anomaly must be transmitted to the site foreman.

5.10.1.2 On the ground

- Check the presence and the position of the stops.
- Check that the track is freed and horizontal.
- Check the correct grounding at the 4 track ends
- Check the passage and the fixing of the supply cable.
- Take the key and the instructions from the site foreman.
- Turn the switch of the site control panel to ON
- Check that the wind speed does not exceed 20m/s
- Unlock the rail clamps
- Check the position and the fixing of the ballast.

5.10.1.3 On the crane tower

- Use the permissible accesses
- Check the presence and the state of the connections
- Check that no article hinders the access platforms

5.10.1.4 On the slewing crane part

- Check the position and the fixing of the ballast.
- From the permissible accesses, check the correct winding, the state, and the tensioning of the ropes.
- Clean and grease the fleeting pulley (according to the model)

5.10.1.5 On the control unit

- Check the presence of the powder-type fire extinguisher
- Press successively upon the ON button (the horn is activated), then on the emergency stop button (movement stop)
- Reset the stop button
- Press upon the ON button and check the functioning of all the movements by means of the control switches
- Check the dead man position of the control switches
- Check the functioning of the displays.
- Check the control of the slewing brake
- By the means of the test button, test the functioning of the sound signal and the signal lamps (flashing lamps) located outside the cab and on the display block (configuration according to model and option)
- Check the functioning of the lighting and the windscreen wipers
- Check without load the functioning of the limit switches
- Check the state of the hook safety catch

All the operations for putting into service of the crane serve to ensure its working under correct driving and safety conditions.

Overall, all these operations can be split up into several groups:

- Checking and carrying out of mounting operations in order to avoid any hindrance as regards the good working order of the crane or safety.
- Carrying out the adjustments of the various safety devices and the working conditions of the crane.

For carrying out any adjustment or maintenance operation and in order to reach the control unit, use the devices provided on the crane.

5.10.2 Checks to be carried out after erection

The execution of the crane erection and the safety require a certain number of operations or checks to be carried out according to the following description:

5.10.2.1 Lower part

Concerned crane parts	Operations to be carried out
Access	➤ Check the fitting of the ladders and back loops, replace damaged parts.
Crane tower	➤ Check the fitting and locking of the mast connecting pins ➤ Check that the indicating plates are present and legible.

5.10.2.2 Slewing crane part

Concerned crane parts	Operations to be carried out
Jib and counter jib	➤ Check the correct installation of the electric supply cable ➤ Check the correct reeving of the hoist and travelling ropes

5.10.3 Operating safety instructions

5.10.3.1 Requirement to the operators

- The crane operator is over 18 years of age.
- The crane operator is reliable, and is physically and mentally adept.
- The crane operator has been instructed in operation of the crane and is familiar with all risks of accident.
- The crane operator has provided proof of qualification to the employer regarding operation of the crane.
- The employer has designated the crane operator for operation of the crane in writing.
- The crane operator must have read and fully understand the instruction manual, in particular the chapters concerning notes on safety, as well as operation and control.
- The crane operator must have read and fully understood the local guidelines valid for accident-prevention.
- The crane operator is familiar with the location and operation of fire extinguishers and has been instructed in the onsite possibilities for fire detection and firefighting.

5.10.3.2 Protective equipment

The following must be worn:



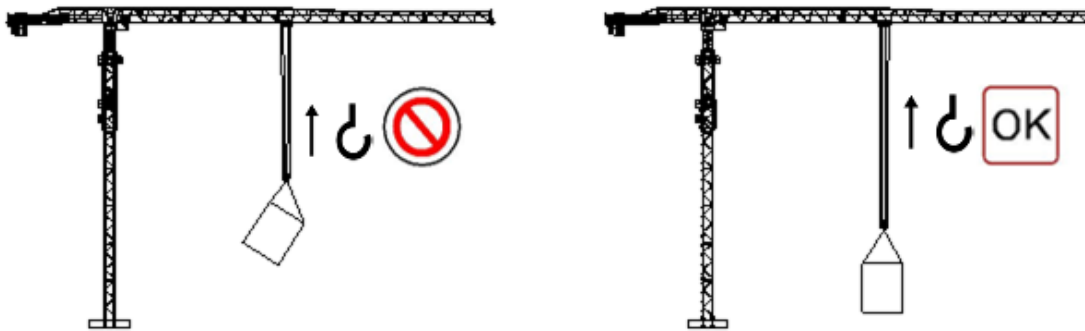
- Safety helmet
- Safety boots
- Safety harness (e.g. for trolley travelling in the event of power failure)

5.10.3.3 Forbidden of operation

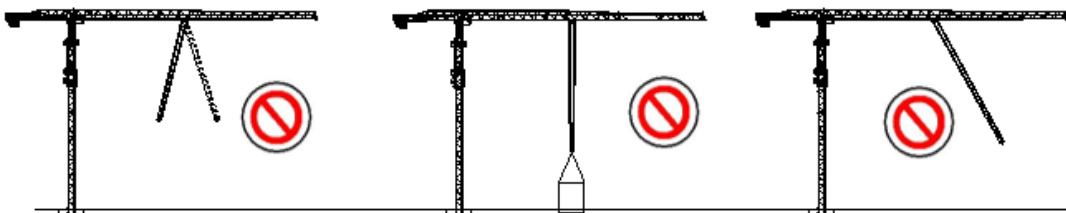


It is strictly forbidden to lift a load the weight of which exceeds the crane capacity. Consult the technical data for handling of loads when their surface/lifted load ratio exceeds $1\text{m}^2/\text{t}$.

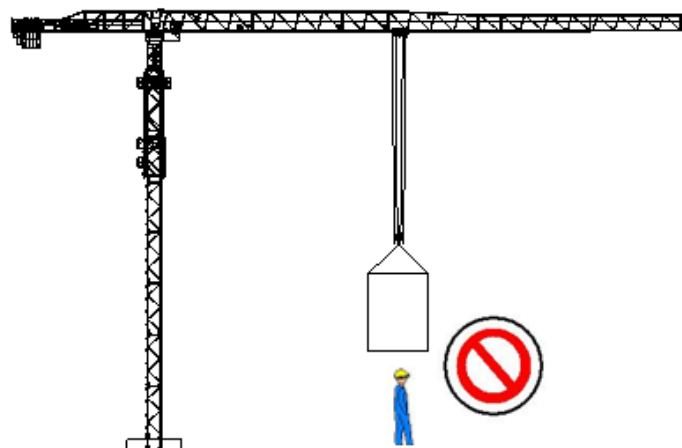
- It is forbidden to lift an incorrectly slung load.



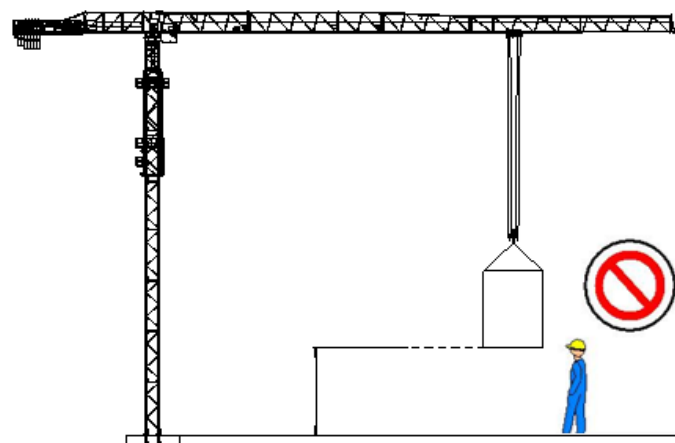
- It is forbidden to generate load swinging, to lift a load adhering to the ground and to lift a load in oblique direction.



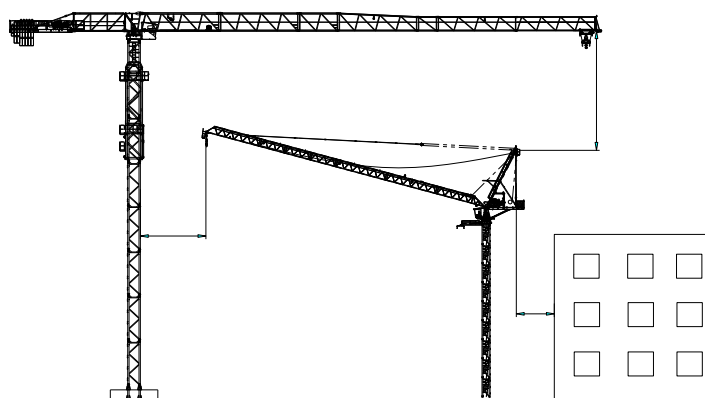
- It is forbidden to slew a load over the staff and roads.



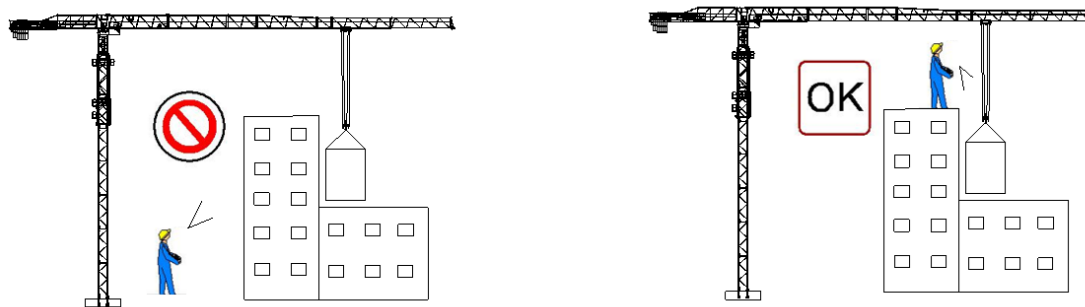
- It is forbidden to handle a load in a space lower than 2 m from the ground.



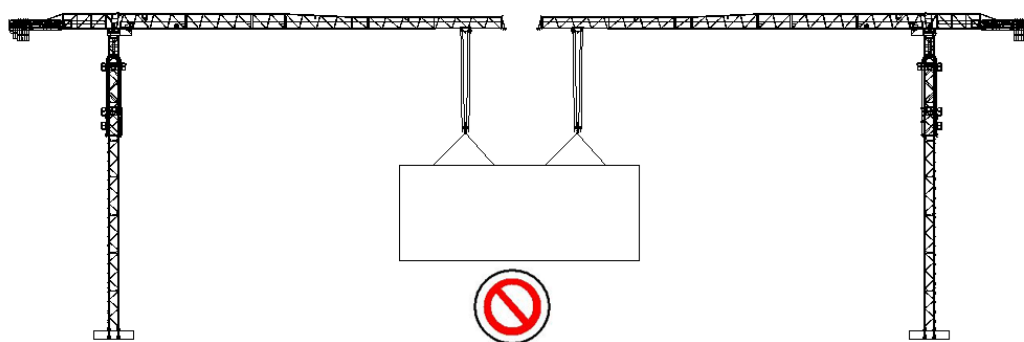
- It is forbidden to erect a crane without observing the prescribed distances.



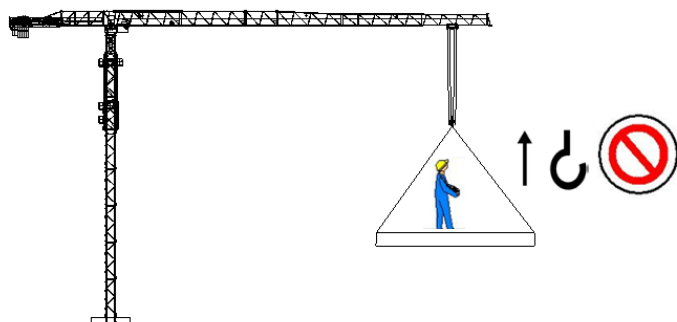
- It is forbidden to handle a load which is not visible without somebody's help.



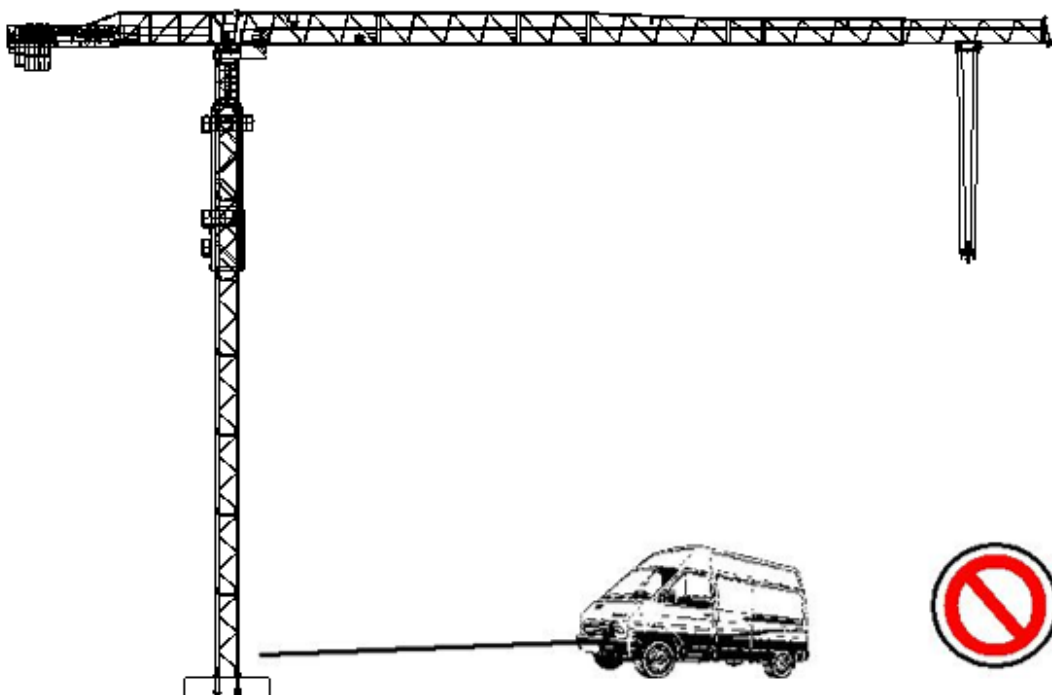
- It is forbidden to lift a load by means of several cranes.



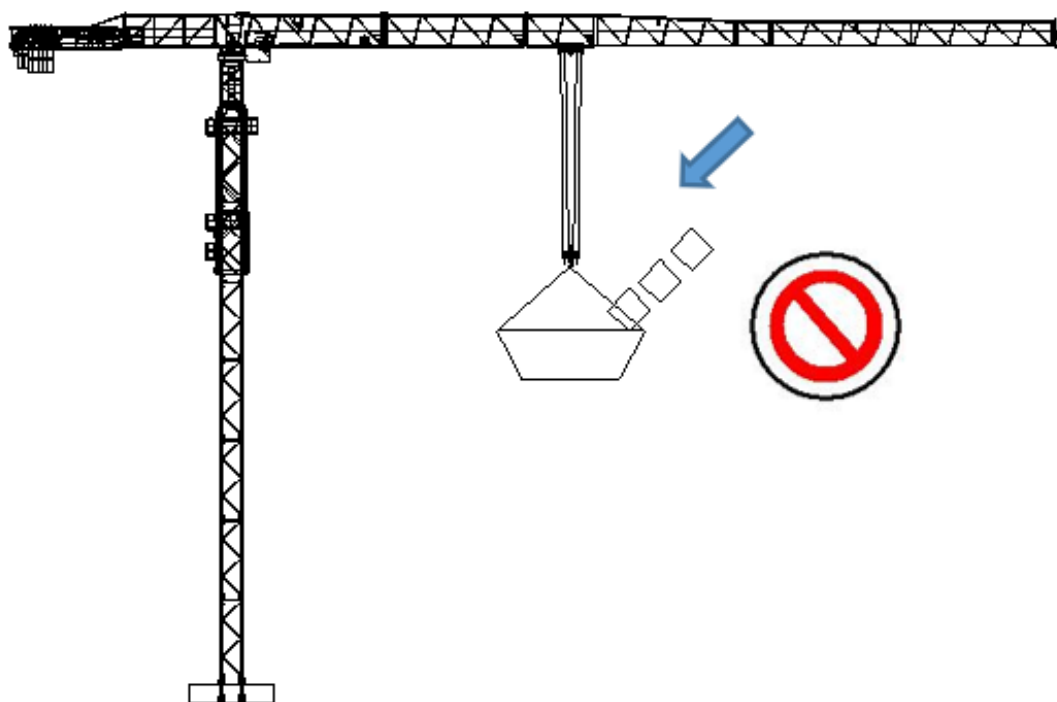
- It is forbidden to lift persons.



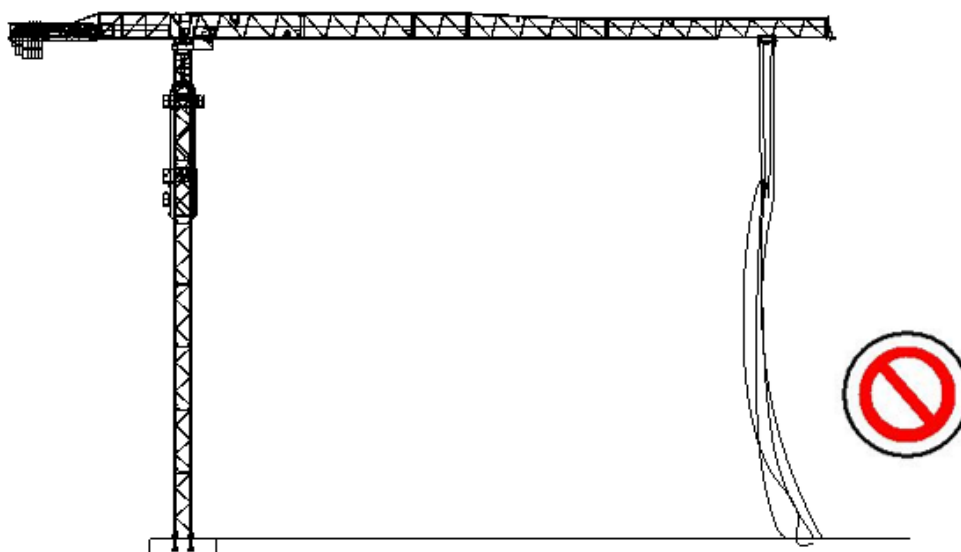
- It is forbidden to use the crane as a pulling device for a load even a rolling one.



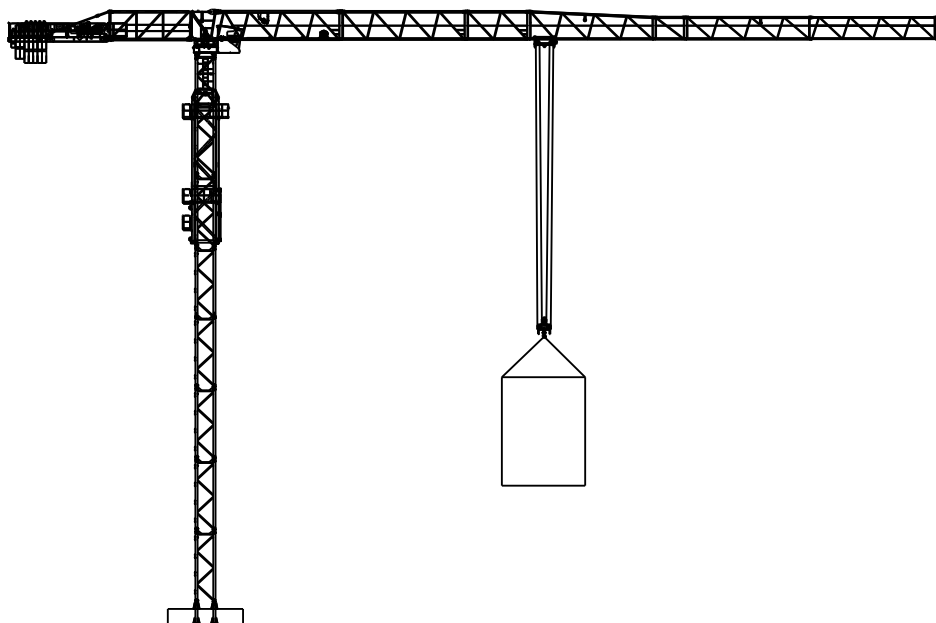
- It is forbidden to fill a grab (or other container) if this one is hooked to the crane, and to stack big objects which could be unstable and fall to the ground.



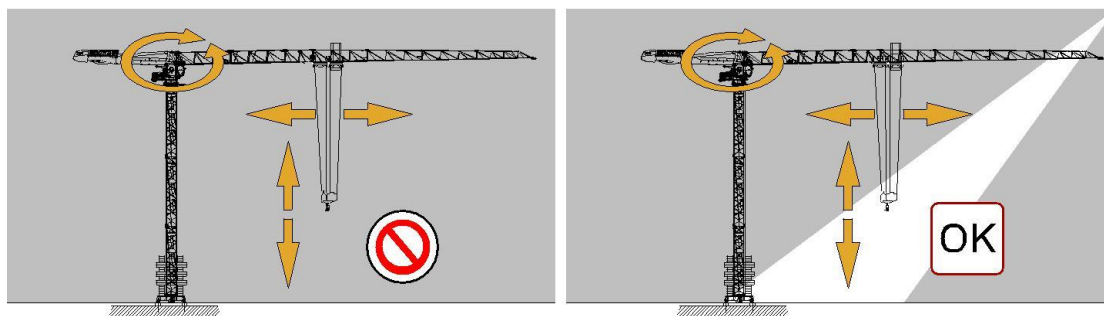
- It is forbidden to lay down the pulley block and to let it on the ground, with slackened ropes.



- It is forbidden load hooked when crane in rest period.



- It is forbidden to work in dimness areas.



- During the normal crane operation, do not stop the movements with the stop button.



- It is forbidden to work until the limit switches, so stop a little bit before.



It is forbidden to modify or to neutralize the moment cutouts, the load limiters, the limit switches, and the interference control system.

5.10.4 Combined operation

By operating the handles of the linkage platform, you can conduct the combine operations of lifting, slewing and trolleying. Pay attention to the following points during the operations:

- During the combined working of the mechanisms, if the system trips, it may because the power supply have no sufficient capacity or fluctuates sharply.
- When there is any mechanism runs too fast and it causes the load shaking, it is not recommended to conduct the combine operations.

5.10.5 Starting up and brake movement

- Starting up

Open the electric switch and turn on the start bottom which on the control unit to starting up the crane.

- Emergency stop

Only when emergency happens, use the “EMERGENCY STOP” Button to stop all movement of the crane.

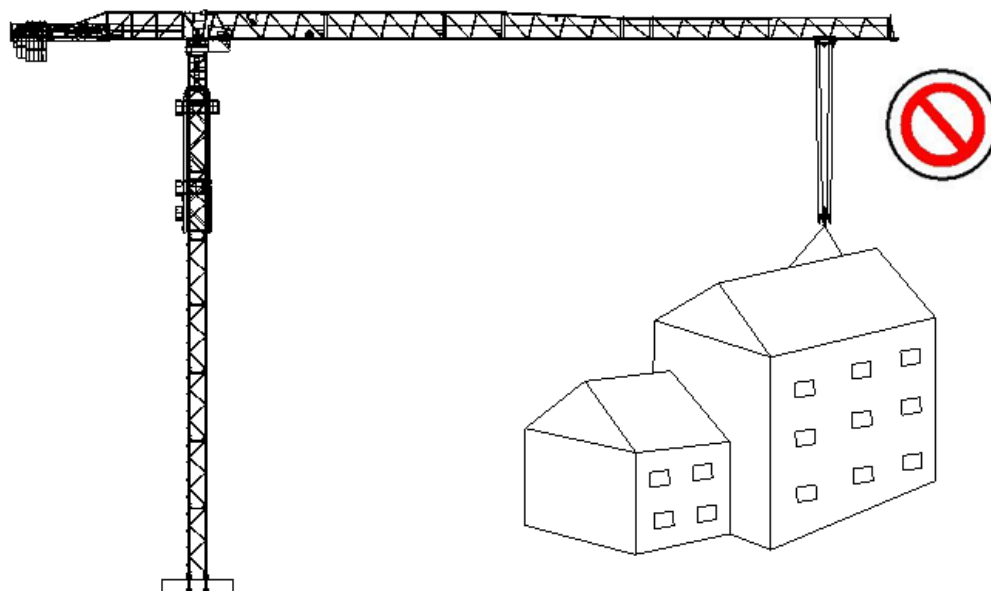
- Slewing brake

Brake switch is on the control unit, use it to stop the crane slewing or release it.

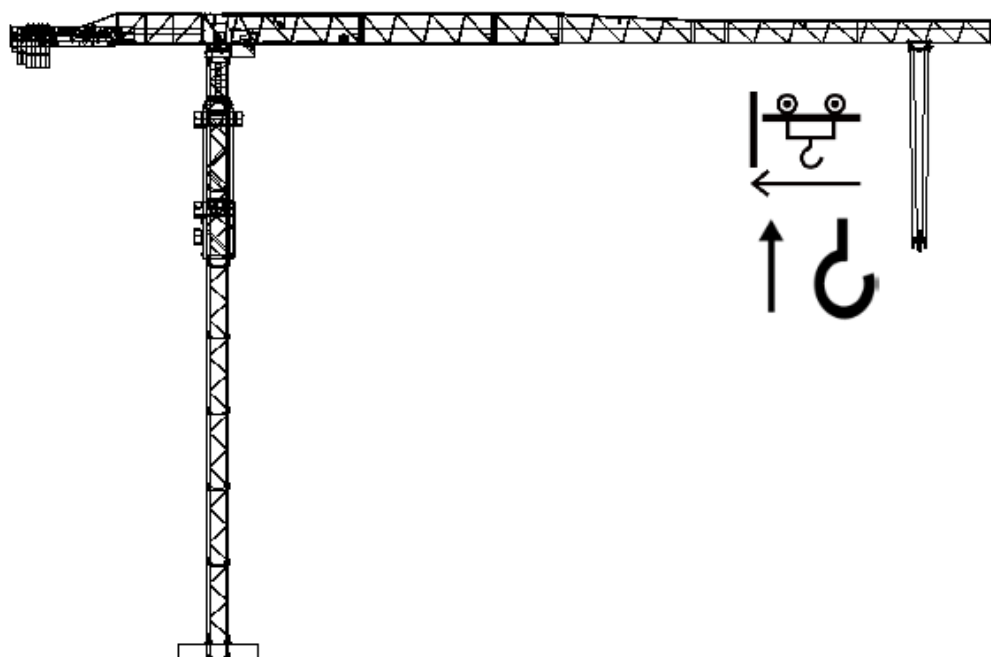
5.10.6 Stopping crane



It is strictly forbidden to hinder the slewing of the jib, as for example, by hooking the pulley block on a fixed point. The crane must compulsorily be in WEATHERVANE position.



- Position the jib in wind direction, lower the load to the ground, raise the hook without load and move the trolley to the jib foot.



6 MAINTENANCE AND INSPECTION

This chapter has been compiled for maintenance personnel who have been designated by the contracting company to keep the crane in nominal operating condition. The maintenance personnel will obtain an overview of all essential maintenance and inspection tasks stipulated in the maintenance and inspection chart.

Especially:

- check the good working order of the crane components.
- carry out the periodically checking.
- carry out the adjustments.
- identify and repair the malfunctioning or failures.
- carry out the greasing.

All maintenance and inspection deadlines can be planned meticulously using the interval specifications.

This part does not comprise instructions in order to carry out:

- repairs requiring a specific tool or which must be carried out in the workshop.
- important operations like overhauling, repairing.

6.1 Lubrication

The lubrication table recommends the type of lubricant to be used and the different lubrication points. Lubricate thoroughly and regularly, since lubrication carried out according to our instructions helps to prevent failures and premature wear.



- **Any repair and maintenance work must only be carried out after the crane has been out of service;**
- **Clean grease nipples and oil drain plugs before lubricating work;**
- **Only the correct use of suitable high-quality lubricants as recommended by a specialist supplier will ensure maximum performance and avoid faults and their consequences;**
- **Only use high quality brand-name lubricants.**

6.1.1 Lubricants table

Table 6-1 Requirements of lubricants for ZOOMLION tower crane are shown as follows

No.	Parts Description	Lubricating location	Specification of lubricants	Oil
1	Wire rope	Hoisting rope Trolley rope	Graphite Calcium-based grease ZG-SSY1405-65	Cleans Spray grease
2	Reducer	Reducer of hoisting mechanism	Industrial closed gear oil L-CKD 150	According to the label on the gear box
		Reducer of trolley mechanism	Fully synthetic gear lubrication oil 4408 (IOS viscosity 320)	
		Reducer of slewing mechanism	1, Environmental temperature -20°C~40°C, 000# general lithium-based grease; 2, Environmental temperature -50°C~-20°C, 7023B# low temperature grease.	
3	Rolling bearing	Drum bearing	Calcium-based grease	/
		Slewing ring bearing		/
4	Slewing ring	Raceway, Tooth surface	1, Raceway, 2# extreme pressure lithium base grease 2, Tooth surface, Graphite Calcium-based grease ZG-S	/
5	Pulley	All pulley	Winter with Calcium-based grease ZG-2; Summer with Calcium-based grease ZG-5.	/
6	Anti-twist device	Bearing	molybdc disulfide Calcium-based grease ZG-1	/
7	Rope roller	Pulley shaft	1, Environmental temperature exceed-10°C, 2# Sodium-based grease; 2, Environmental temperature under-10°C, grease thin oil	/
8	Hydraulic pump station	Oil tank	Hydraulic oil for anti-wear L-HM 46	/
9	Hook	Bearing	Grease oil	/
10	Electro-hydraulic thrust	Brake	DB-25	/

6.1.2 Lubrication for bearing

6.1.2.1 The function of lubrication

There should be sufficient lubrication during the working hours of the bearings to achieve effective and reliable movement. The function of bearing lubrication is as follow:

- Avoid or lessen direct metal contact among rolling element, raceway, and cage of a bearing to reduce wear.
- Oil membrane formed on the friction surface can enlarge the bearing area of the parts and lessen the contact stress to achieve the benefits of prolonging rolling contact fatigue life.
- Lubricant has a certain effect of antirust and anticorrosion.
- Grease can improve sealing performance and prevent the invasion of outer pollution.
- Lubrication has a certain effect of damping and noise-reducing.

6.1.2.2 Grease

The general used grease in the bearings of tower cranes is Calcium-based grease.¹ Filling amount of grease.

The filling amount of grease varies with the structure of bearing, space, operation speed and the different kinds of grease. The filling amount of grease is consisting of two parts, one filled in the inside of bearings, the other filled in the bearing seats.

The filling amount of grease could be decided by the ratio of allowed limiting rotational speed to practical working speed. The factor shows in Table 6-2:

Table 6-2 The factor shows in table

Speed ratio(limit/n=A)	Filling amount
$A \leq 1.25$	Grease accounts for 1/3 of the free space of the interior of the bearing
$1.25 < A \leq 5$	Grease accounts for 1/3 to 2/3 of the free space of the interior of the bearing
$A > 5$	Grease accounts for above 2/3 of the free space of the interior of the bearing

6.2 Safety notes

6.2.1 Requirement on personnel

The maintenance personnel must be designated by the operating company. Maintenance of the crane requires specialist knowledge of crane technology. The operating company is responsible for all damage caused as a direct result of improper maintenance.

6.2.2 Safety measures

- Switch off the crane and secure against incorrect or unauthorized restart.
- If there is any danger of falling objects: Cordon off the danger area or secure the area with warning signs.

6.2.3 Protective equipment for personnel

The following must be worn:

- Safety helmet
- Protective gloves
- Safety boots
- Safety harness when working above head height
- High-visibility clothing



6.3 Required maintenance and inspections

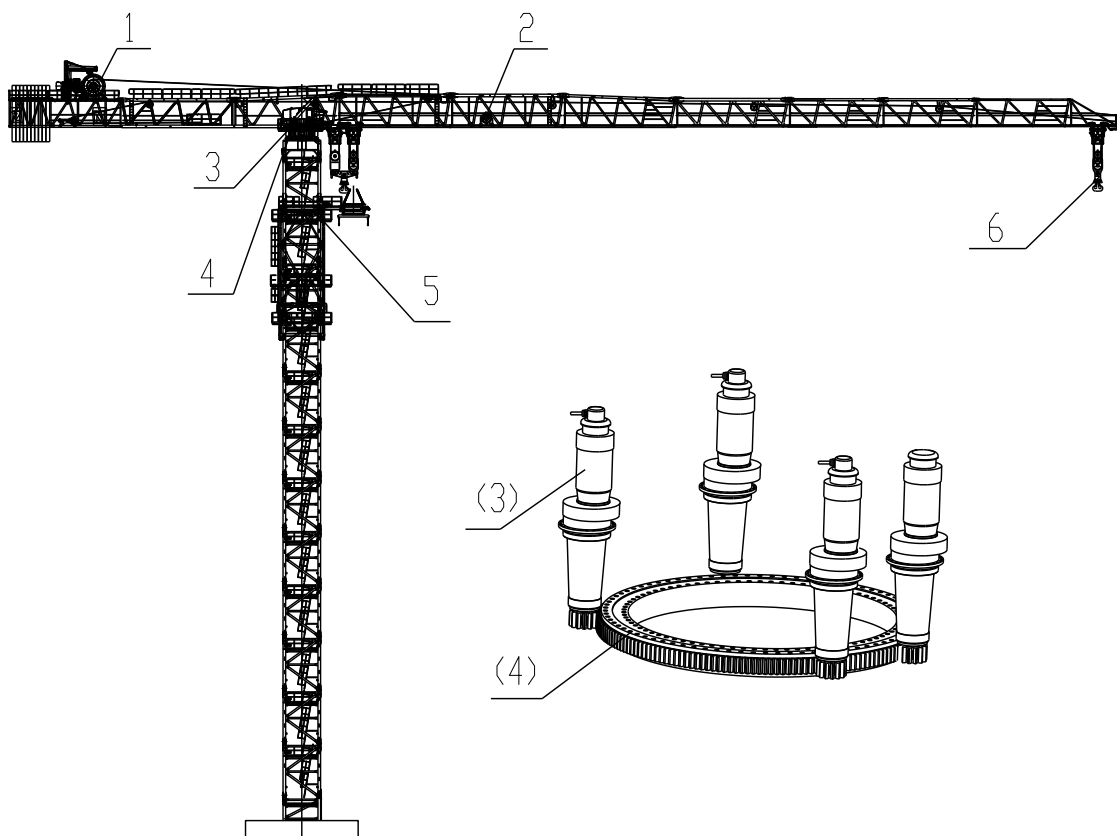


Fig. 6-1 Parts required for maintenance

- | | |
|------------------------|-----------------------|
| (1) Hoisting mechanism | (2) Trolley mechanism |
| (3) Slewing mechanism | (4) Slewing ring |
| (5) Climbing unit | (6) Hook |

The designated personnel must carry out the maintenance and inspection tasks according to task guidelines as follows:

Maintenance/inspection intervals	Task to be performed
Check when starting up the crane and before every erection.	Slewing ring ^③ : Grease the ball track and gear teeth
	Check the wire ropes and rope end fittings
	Check the hook ^⑥
	Telescoping equipment ^④ : Grease the Pins and guide section rollers
	Check the twist compensator during every erection
	Grease all Pins during every erection
	Check each framework part and connective part
	Check each electric control implement and security implement
	Check the quality and quantity of the oil in the reducer of hoisting mechanism
	Check the quality and quantity of the oil in the climbing mechanism
Daily check	Slewing mechanism ② brake
	Trolley mechanism ⑤ brake
	Hoisting mechanism ① brake
	Travelling mechanism brake
	Rope release implement
Weekly maintenance	Slewing ring ^③ —Grease the gear teeth, see Fig. 6-1
	Check the electric control implement, cable and electric wire
	Check the security implement (load moment limiter, load limiter, troling limiter, slewing limiter, hoisting limiter)
Monthly maintenance	Grease the wire ropes
	Grease the rope pulleys
	Grease the winch drum bearing
	Fill with hydraulic oil in the climbing pump station
	Inspect the high-tensile bolt connections 1 month after erection
	Travel gear: Grease the wheel bearings and the inside face of the flanges
	Hoisting gear ^① : Fill the reducer with Oil
	Check the stability of the vital framework, important weld and connection parts (bolts and pins)

Maintenance/inspection intervals	Task to be performed
Half-yearly maintenance	Grease all lubricating nipples
	Check the twist compensator
	Motor bearing: change oil after 1500 operation hours, once a year at least
Yearly maintenance	Inspect the high-tensile bolt connections and grease the bolt
	Check the hook⑥
	Check freedom of the movement of the hinged joint of front window of the cabin and lubricate it regularly
After 2000 operation hours	Oil change in the reduction of slewing mechanism②
	Oil change in the reduction of hoist mechanism①
	Oil change in the reduction of trolley mechanism⑤
	Oil change in the brake of hoisting mechanism ①
	Oil change in the trolley travel reducer
	Oil change in climbing mechanism④ after 2400 operation hours

Table 6-3 Common bolt pre-tightening force (friction coefficient $\mu=0.14$)

Bolt performance grade	8.8	10.9
Thread specifications	Actual use of pre-tightening force N·m	Actual use of pre-tightening force N·m
M8	22.5	31.5
M10	44	62
M12	77.5	110
M14	120	170
M16	190	265
M18	260	365
M20	370	520
M22	500	700
M24	640	900
M27	950	1350
M30	1300	1800

6.4 Hoisting mechanism

6.4.1 Overview

The structure of the hoisting mechanism is shown in the figure below. There are five gears in the process of hoisting or falling. The first and second gears are transition gears which can be used for slowly locating operation.

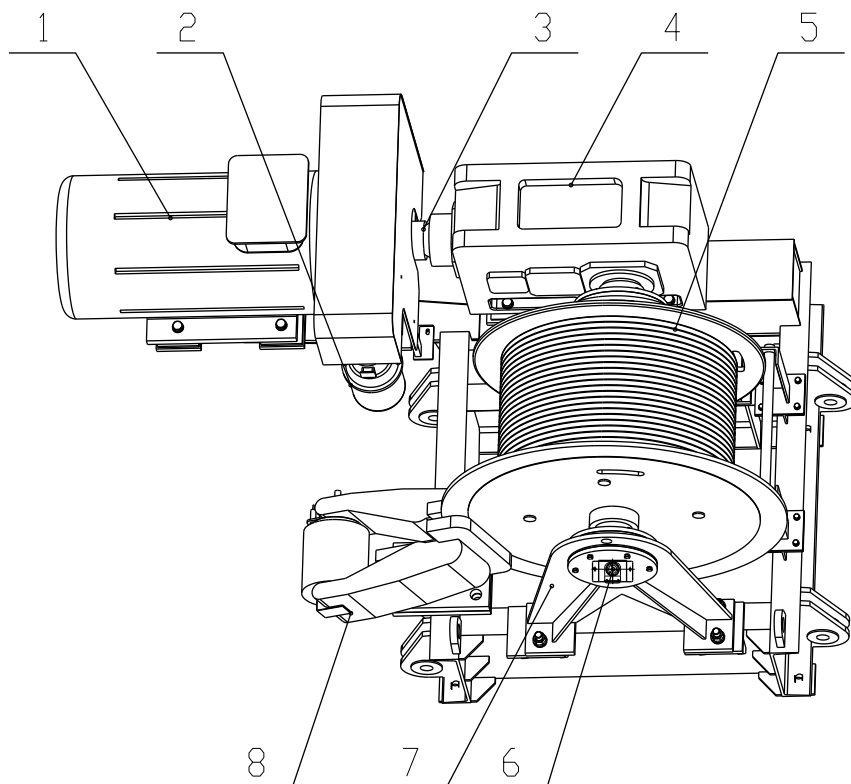


Fig. 6-2 Hoisting mechanism

- | | |
|--------------------|-------------------------------------|
| (1) Electric motor | (2) Brake |
| (3) Coupling | (4) Reducer |
| (5) Drum | (6) Hoisting absolute-value encoder |
| (7) Bearing seat | (8) Safety brake caliper |

6.4.2 Adjustment and maintenance of the brake

The type and relevant parameter of the hoisting mechanism brake are shown in the table below.

Table 6-4 Relevant parameter of Brake

Type	Rated braking moment (Nm)	Suggested braking moment (Nm)
YWZ501-500/300- II A- WC.RL.HL	2000~5400	5050~5100



Make sure drum not rotation unexpected leads to accidents before any debugging for brake.

6.4.2.1 Adjusting the brake

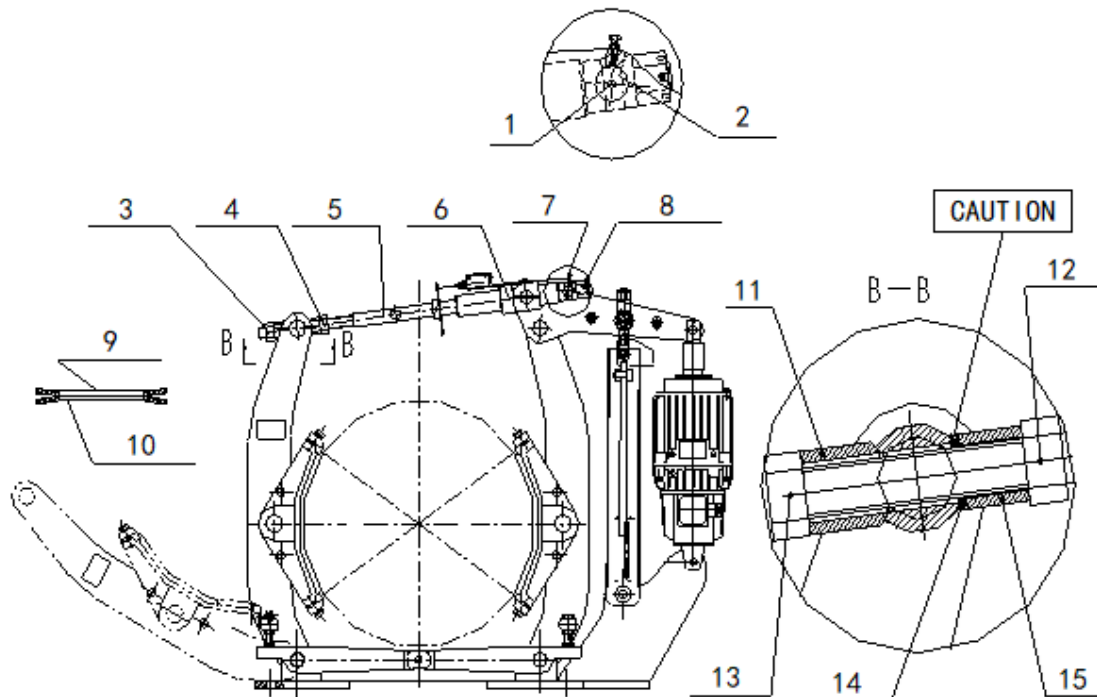


Fig. 6-3 Hoisting mechanism brake

- | | |
|--------------------------------------|-------------------------------------|
| (1) Pull pin | (2) Compensation cover |
| (3) Locknut 2 | (4) Locknut 1 |
| (5) Braking tie bar | (6) Compensation device |
| (7) Fastening screw | (8) Back-off adjusting nut |
| (9) Dish washer (near Spacer bush 2) | (10) Dish washer (near Braking jib) |
| (11) Spacer bush 1 | (12) Locknut 1 |
| (13) Locknut 2 | (14) Dish washer |
| (15) Spacer bush 2 | |



It is prohibited to press the two locknuts together completely when screwing the Locknut 1. Each of the locknut can be compressed for at most 0.5mm, which means the maximum compression is 1mm.

The adjustment of the brake mainly includes the adjustments of: the braking moment, the shoe clearance (compensation for travel of the pusher h_b) and the shoe clearance balancing.

6.4.2.1.1 Adjustment of the braking moment

As the following figure shows, when using the wrench to screw the nut clockwise, the spring shorten and the braking moment increases; when screwing anticlockwise, the moment decreases.

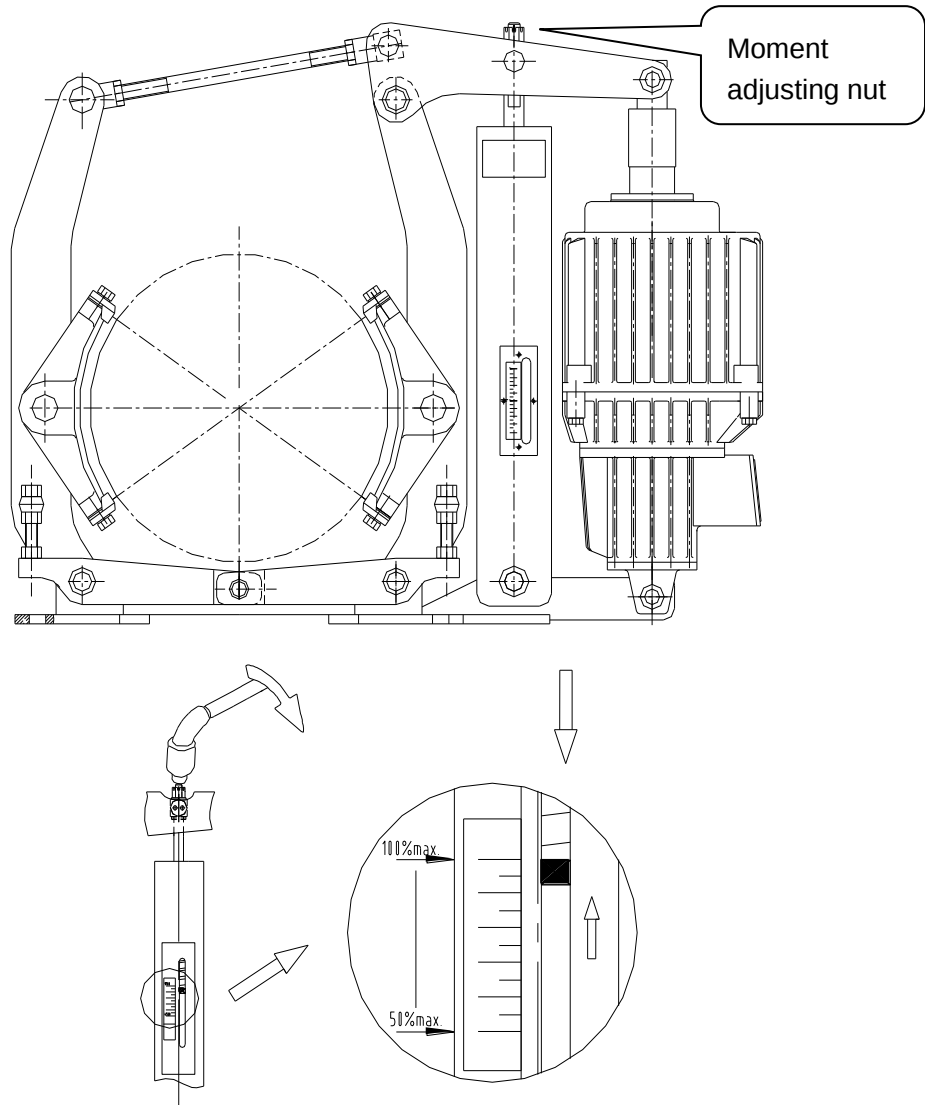


Fig. 6-4 Adjustment of the braking moment



Don't overstep the range on the moment scutcheon when adjusting the braking moment, otherwise the brake may work unmorally.

6.4.2.1.2 Adjustment of the shoe clearance

- 1) Open the brake by electrifying or manual release device (If it's not opening enough, open wider by adjusting the braking tie bar or back-off adjusting nut);
- 2) Screw the back-off adjusting nut clockwise for 3~5 circles, then close the brake;
- 3) Measure the compensation for travel of the pusher h_b as the following figure, then repeat the step 2) until the h_b correspond with the rated value in the following table.
- 4) Screw the locknut 1 on the brake tie bar tightly after the adjustment (caution that It is prohibited to press the two locknuts together completely when screwing the Locknut 1. Each of the locknut can be compressed for at most 0.5mm, which means the maximum compression is 1mm.)

Table 6-5 The compensation for travel of the pusher h_b

Type	Rated h_b (mm)	Minimum h_b (Nm)
YWZ501-500/300- II A- WC.RL.HL	20±2	6

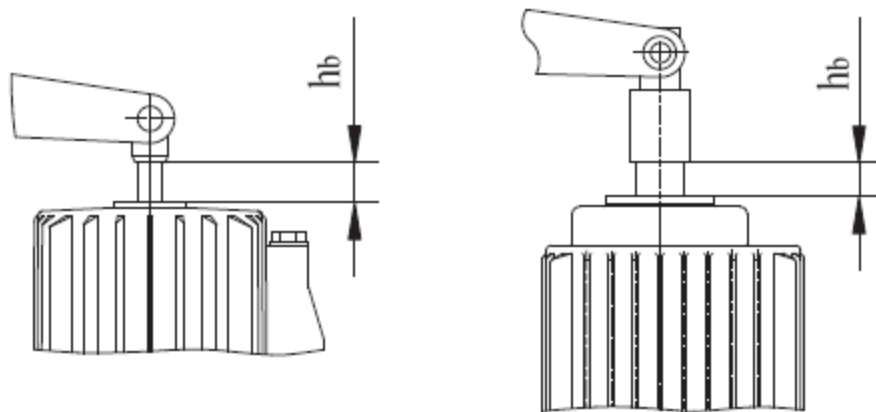


Fig. 6-5 Adjustment of the shoe clearance

6.4.2.1.3 Adjustment of the shoe clearance balancing

As the following figure shows, open the brake, observe the gap between the braking gasket and the braking wheel. If the gaps of two sides are not equal, screw out the locking nut of the wider gap side, and screw the adjusting bolt clockwise and keep observing, stop screwing when the gaps are equal. Finally screw in the locking nut. This device is an automatic balance device, once be adjusted well, it's no need to adjust again in the working process. If it appears badly unbalanced shoe clearance in the working process (appearance of the braking gasket on the one side floating over the braking wheel when the brake is releasing), it may because the locking nut of the shoe clearance balancing device is loose. To deal with it, just close the brake and screw in the locking nut tightly.

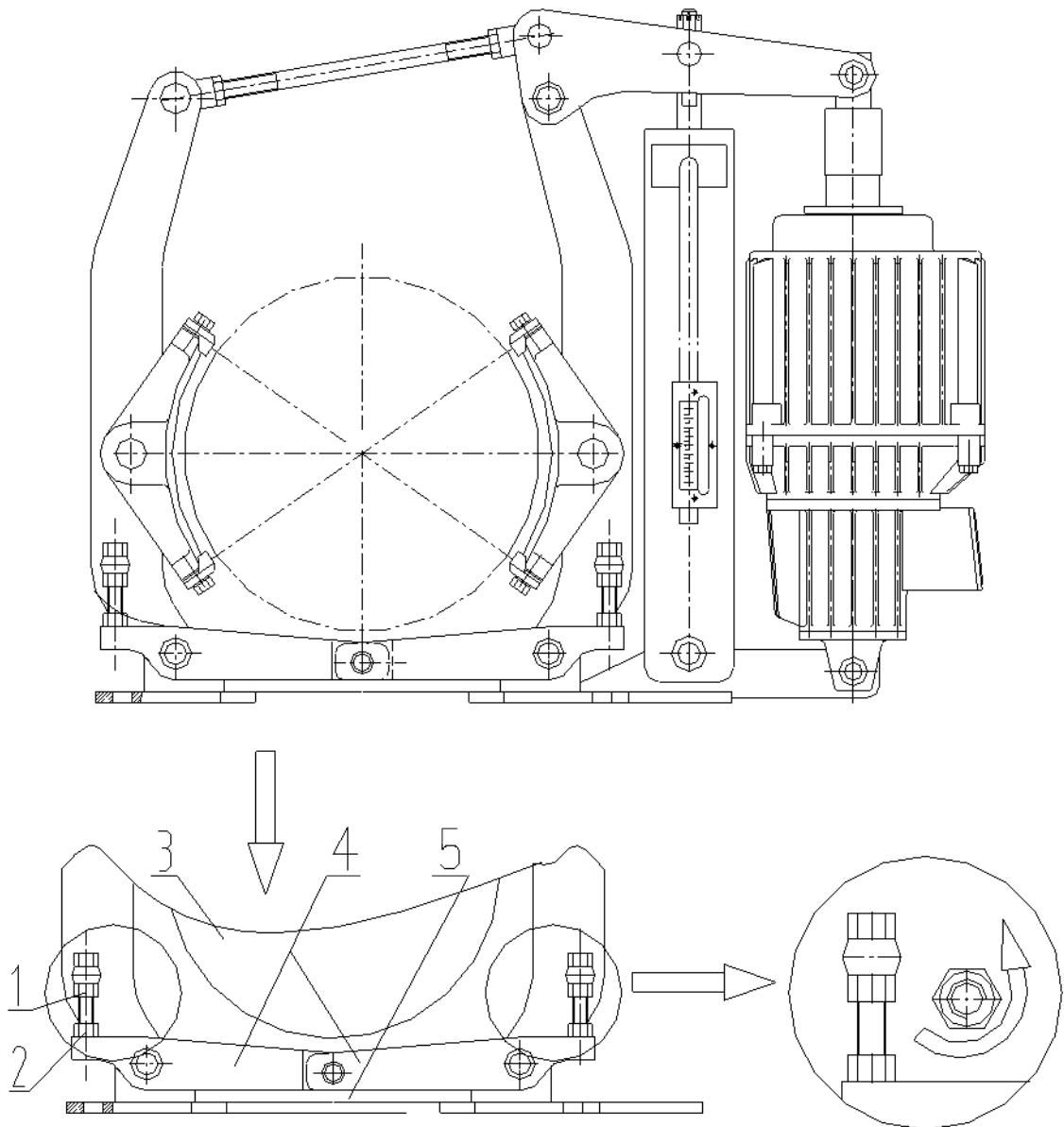


Fig. 6-6 Adjustment of the shoe clearance balancing

- | | |
|-------------------|-------------------|
| (1) Locking nut | (2) Locking nut |
| (3) Braking wheel | (4) Balance lever |
| (5) Distance | |



Keep the balance levers almost horizontal. Keep the distance (5) between the bottom of the middle of the balance levers and the bottom plate not less than 8mm, and keep the distance between the top of the balance levers and the braking wheel not less than 5mm.

6.4.2.2 Replacing the braking gasket

- 1) Open the brake to the widest position;
- 2) Unscrew the bolts of the pressing plate on the top of the gasket, take down the pressing plate and the adjusting washer;
- 3) Hold the gasket and push to the side of the brake wheel, pull out the gasket to be replaced along the edge of the braking wheel;
- 4) Infer to the following figure, insert a new braking gasket to the right position, assemble the (5) (4) (3) (2) successively and screw the (1) tightly;
- 5) After inserting the braking gasket, check the brake and ensure it's alright, then make the brake run statically for 20~30 times, which means the main motor is power-off, the brake runs for each 5s with 40% braking loads, operate the brake in this working condition intermittently for 25~30 times. Observe if there is any unusual situation, if yes, find out the reason and deal with the problem until the brake is normal;
- 6) Adjust the braking moment to 50% rated value, take a dynamical pilot run for 15~20 circulations with 30%~50% braking loads. Observe the braking length is almost the same or not, if yes, stop the pilot run.



Keep the new braking gasket fitting to the braking shoe clearance well, the gap on the fitting surface can't be over 0.5mm, and the top of the gasket should higher than the top of the shoe clearance for 1.2~2.0mm, so that the gasket can be pressed tightly and be reliable. Besides, the thickness of the gaskets of the pressing plates and baffles of two sides can't be over half of the original thickness of the gasket but not less than the 1/3 (with the thickness of steel back plate).

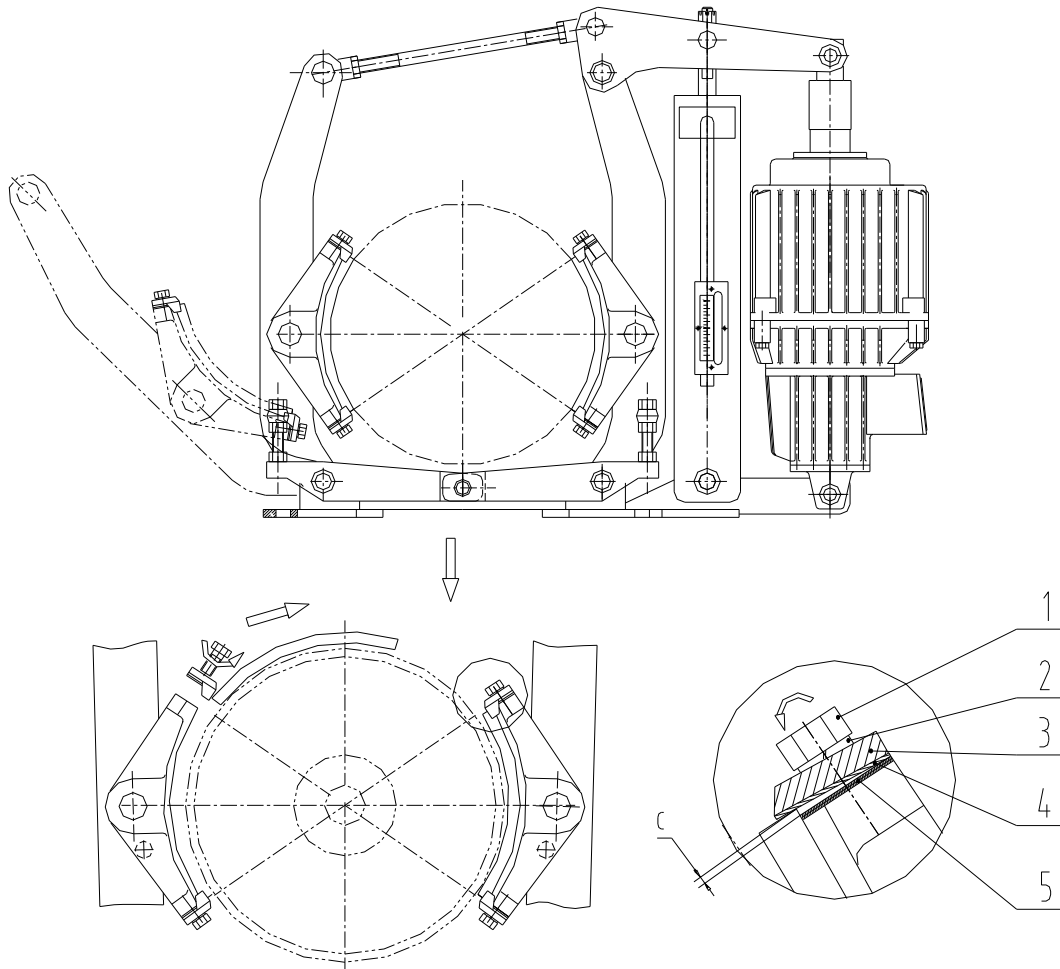


Fig. 6-7 Adjustment of the shoe clearance balancing

- | | |
|----------------------|-------------------|
| (1) Bolt | (2) Spring washer |
| (3) Pressing plate | (4) Baffle |
| (5) Adjusting washer | |

6.4.2.3 Maintenance of the brake

- 1) Inspect the brake for every 1~3 days (according to the actual situations), the things to be inspected are:
 - The shoe clearance is normal or not;
 - The static length of the spring is changed or not;
 - The touch plate of the limit switch is loose or not, the position of the limit switch is correct or not;
 - The surface of the brake or braking gasket are contaminated by oil or not;
 - The wear of the braking gasket (If the thickness of the gasket is less than 3mm, the gasket must be changed, then adjust and run the brake for adaptation.);
 - The crack on the brake wheel, change the wheel if there is any deep crack.

- 2) In the working process, the following situations must be inspected if occurred:
- The braking time or distance increases abnormally;
 - The braking wheel is overspeed;
 - The movement of the limit switch is abnormal;
 - The braking wheel or gasket is keeping hot (over 350°C) or smoking. If occurred, stop the crane, and find out the cause, solve it then the crane can be used again;
- 3) Paint mending: The paint on the brake can be damaged in the transporting, saving, installing, or working processes. The paint damage must be touched up in time, otherwise the antiseptic performance of the surface will reduce. The following parts are prohibited to be contaminated in the paint touch-up process:
- Every hinge joint;
 - The rubbing surface of the braking wheel and gasket;
 - The surface of the automatic compensating device and the push rod of the pusher;
 - The surface of the shafts.
- 4) Lubrication: Every hinge joint of the brake is self-lubricating composite bearing which is no need to add lubricating oil;
- 5) Replacing the braking gasket: The braking gasket will wear out and be thinner after working for some time. When the thickness of the gasket is less than 3mm, the gasket should be replaced. Caution that the gasket is heavy when replacing. Please inspect, adapt, and take a pilot run after the replacing;
- 6) Maintaining the brake: The brake has been filled with hydraulic oil when leave factory. The pusher is a maintenance-free product (As the following figure). After working for a long time, the hydraulic oil will be muddy and must be replaced. Generally, the hydraulic oil should be replaced for every 1~2 years according to the actual situations. Replace the hydraulic oil refer to the processes below:
- Remove the brake pusher and deliver it to the repairing workbench;
 - Screw out the oil inlet plug and remove all the hydraulic oil inside;
 - Fill the pusher with new hydraulic oil to the marked oil level.
- (The types of the hydraulic oil according to the following table or nameplate on the product.)

Table 6-6 The types of the hydraulic oil

Surrounding Temperature	Type	Standard
-25°C~+50°C	DB-25	/
	DTE-21 (Mobil)	ISO VG15
	HL-10	DIN51524
<-25°C	YH-10	/

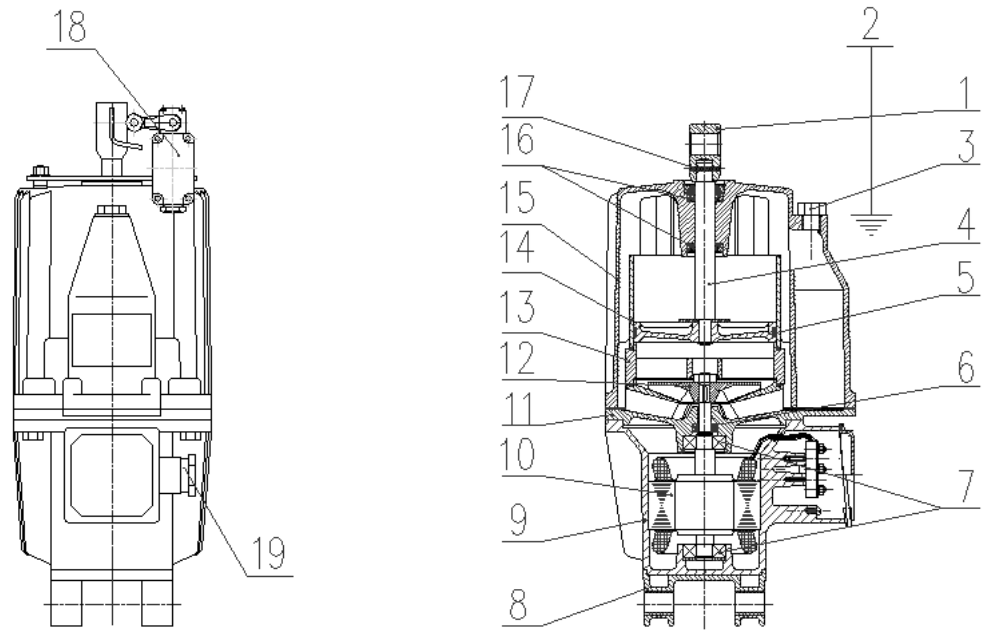


Fig. 6-8 Parts of the braking pusher

- | | |
|------------------------|------------------------------|
| (1) Head of pusher rod | (2) Oil level mark |
| (3) Oil inlet plug | (4) Piston rod |
| (5) Piston | (6) Sealing element of motor |
| (7) Bearing | (8) Support |
| (9) Shell of motor | (10) Motor |
| (11) Middle flange | (12) Impeller |
| (13) Oil guiding plate | (14) Cylinder sleeve |
| (15) Cylinder | (16) Sealing element of rod |
| (17) Spring pin | (18) Limit switch |
| (19) Line-in hole | |



Ensure the hydraulic oil has cool down to the surrounding temperature before observing or replacing, otherwise once the oil inlet plug opened, the heated oil may splash out!



Ensure there is no any impurity in the added oil (filter it if necessary). To exhaust the air in the cylinder and ensure enough filling, pull and push the pusher rod slowly for several times when filling the oil.

If the brake works as S3, 60% brokenly, the pusher must be heavy repaired or the brake be replaced for working 5,000,000 times or 10,000 hours.

6.4.3 Maintenance of the motor

6.4.3.1 Storing the motor

The motor should be stored in the dry and ventilated place and be covered by rain cloth. Keep the motor clean, avoid any water, oil, dust, or corrosive gas get into the motor, and clean the dust inside or outside the motor regularly.

For the motor stored over one year, clean the impurity inside and dry, apply a coat of clean anti-rust oil to the bearing, all the fasteners (except the earthing bolts) and fitting surfaces.

The cover plate, junction box cover and unused outlet should be covered well, for avoiding things as water, dust, oil, or emulsion get into the motor, and caution the mouse destroying the coil.

6.4.3.2 Maintenance before use the motor again

- 1) Observe the motor and transmission after starting, if any abnormal situation occurs, stop the motor immediately, find out the cause and solve it, then the motor can restart;
- 2) The increase heat of the working motor is prohibited to exceed the permission value. Using the temperature gauge to measure the heat increase of the iron core or shell, generally the increase can't exceed 60K, the increase of bearing can't exceed 95°C, always monitor the heat increase of the parts in the working;
- 3) Notice the smell, vibration, and noise of the motor. The winding will scorch with smell because overheat. Some problems, especially the mechanism problem, will show as vibration or noise, so the motor should be stopped immediately when the abnormal smell, vibration, and noise occur;
- 4) Check if the bearing is overheating or oil-leaking constantly, and pay attention to supplement or replace grease regularly. The grease is generally made of No.2 lithium grease. Use the same grease as possible, the grease in the bearing room should not exceed 70%;
- 5) Keep the motor clean, no water, oil and impurities can fall into the motor. The air inlet and outlet must always be unobstructed;
- 6) If the motor leaves unused for a long time, mind to deal with the exposed parts of the motor by dustproof and waterproof treatment. When use again, take a mechanism check before installing, check if the assembly is complete, if the fasteners are loose. The dust or impurities inside should be cleaned if there are, use dry compressed air to clean if necessary. Must use 500V megohmmeter to measure the insulation resistance between the stator winding and the shell. If it's lower than 0.5 MΩ, the motor must be dried, charging in low-voltage electric is a suggested way. The temperature of the winding is not allowed to exceed 125°C. To avoid the motor rusting, when assembling after the excreting and checking, all the fasteners (except the earthing bolts) and fitting surfaces should be applied with a coat of clean anti-rust oil. All the fasteners should be attached with spring washer to avoid loose. After the assembling, rotate the rotor by hands, the rotor should roll flexibly and have no friction.



Avoid to crash, knock the brake and rotary encoder in the tail of the motor. Check if the brake and rotary encoder are assembled completely and installed right, and if the fasteners are loose.

6.4.4 Maintenance of the reducer

6.4.4.1 Period of the maintenance

Users should maintain the reducer regularly according to the items in the following table:

Table 6-7 The period of the reducer maintenance

Check items	Period	Remarks
Check the oil temperature	Everyday	
Check the abnormal noise of the reducer	Everyday	
Check the oil level	Every month	
Check oil leaking of the reducer	Every month	
Check the water contain in oil	After worked 400 hours, at least once a year	
The first-time replacing oil after started	After worked 400 hours	
Oil replacing afterwards	Every 18 months or after worded 5,000 hours	
Clean the oil filter	Every three months	
Clean the vent bolt	Every three months	



If the motor leaves unused for a long time, mind to deal with the exposed parts of the motor by dustproof and waterproof treatment. When use again, take a mechanism check before installing, check if the assembly is complete, if the fasteners are loose. The dust or impurities inside should be cleaned if there are, use dry compressed air to clean if necessary.

6.4.4.2 Oil adding of the reducer

The spare parts of the reducer are as following figure:

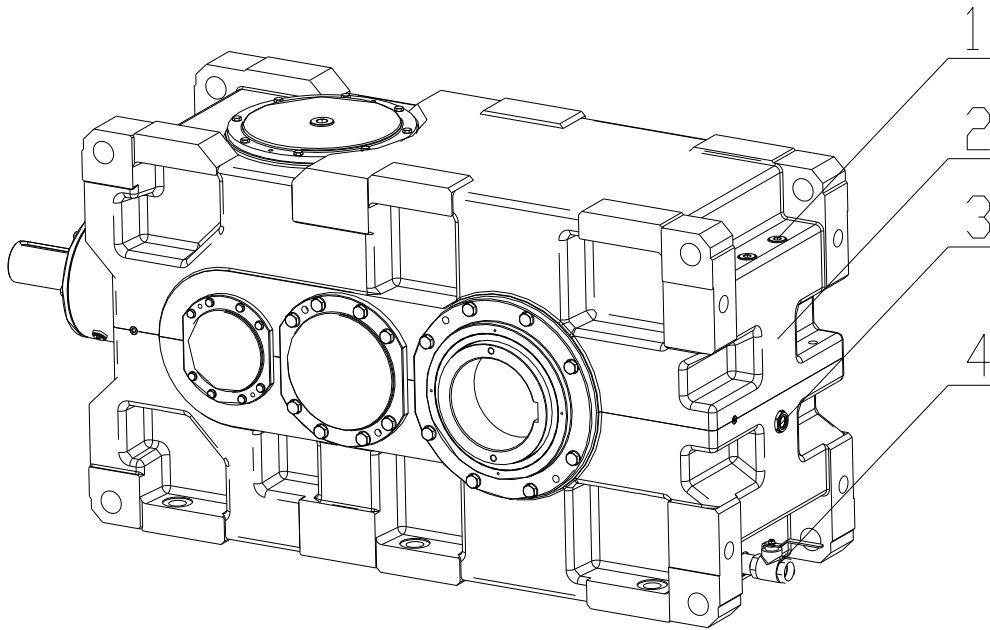


Fig. 6-9 Parts of the Hoisting reducer

- | | |
|----------------|--------------------|
| (1) Oil inlet | (2) Box |
| (3) Oil mirror | (4) Oil drain plug |

Filling steps:

- 1) Take down Part 4 oil drain plug, put the waste oil of the reducer clean, and install the oil drain plug;
- 2) Open the Part 1 oil inlet, and add the gear oil that meets the requirements of the lubricant Table 6-1 to the reducer.
- 3) Observing through Part 3 oil mirror, adding oil until the oil level is in the middle of the dipstick.
- 4) Install Part 1 oil inlet



Refueling or oil change should be carried out when the machine is shut down and the temperature of the reducer is reduced to room temperature, otherwise unnecessary may occur.

6.4.5 Coupling

- Allowable motor axle deviation inspection
- Check the motor axle deviation of coupling from the inlet shaft of the reducer. Axial deviation $\leq 4\text{mm}$, radial deviation $\leq 1.5\text{mm}$, angle deviation $\leq 1^\circ$ and radial run-out of braking wheel $\leq 0.7\text{mm}$. If the value goes beyond, please adjust it into the prescribed limit or contact after-sales service of our company;
- Check the coupling elastomers and half-coupling, if damages or cracks are found, please stop operate or contact after-sales service of our company to check and change it.



If the value goes beyond, please adjust it into the prescribed limit or contact after-sales service of our company.

- Coupling elastomers and half-coupling inspection



If damages or cracks are found on coupling elastomers and half-coupling, please stop operating or contact after-sales service of ZOOMLION for replacement.

6.4.6 Method of Rope Arrangement Problem of Hoisting Mechanism

Mechanism

Rope of tower crane hoisting mechanism is multilayer coiling. The drum is lebus drum which is fit for multilayer rope coiling. The characteristic is most of the rope race is straight line rope race. The under-layer rope arrangement has obvious guide effect to the upper rope arrangement. It is not easy to lead to rope climbing and rope disordering phenomena and is helpful to arranging multilayer rope coiling orderly. Rope arrangement of hoisting mechanism is shown in Fig. 6-10.

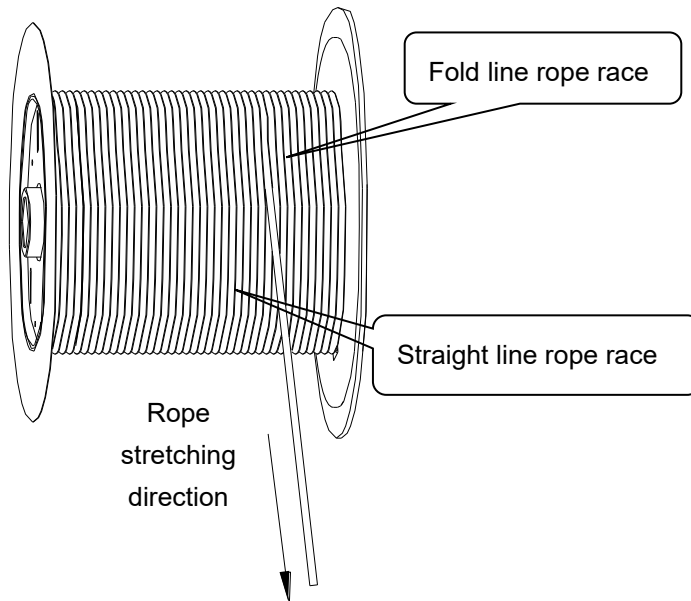


Fig. 6-10 Drum structure

Table 6-8 Rope arrangement problem summary of hoisting mechanism

Rope arrangement problem summary		
Problems description	Reason analysis	Handling Method
Bad rope arrangement and rope jumping of drum	Bad lubrication of A-frame guide pulley leads to clamped pulley cannot guide well.	Check the lubrication condition, if dry lubricating grease is found, wipe it off and paint new lubricating grease. If the environment temperature is too low and viscosity of lubricating grease is too high, add thin grease to the pulley (Check before starting the machine and paint thin grease if necessary).
	Hoisting mechanism is installed aslant	Check whether the bracket is installed aslant, if yes, adjust it.
	Center lines of hoisting mechanism drum and counter jib are not aligned	Adjust mechanism installation seat to let the center lines of hoisting mechanism drum and counter jib be aligned.

Rope arrangement problem summary		
Problems description	Reason analysis	Handling Method
	Bracket of hoisting mechanism is not installed flatly	Check the flatness of the bracket. If it is not flat, adjust it.
	Upper layer rope is pressed under the lower layer rope of the drum	Check if the first layer rope is arranged tightly, if not, arrange it tightly with some load (2% of the minimum broken tension of the rope or 10% of rated hoisting load)

CAUTIONS:

- The lubricating condition has some effects to the rope arrangement. Check the lubricating condition of the rope. If dry lubricating grease is found, wipe it off and paint new lubricating grease.
- If rope disordering occurs, arrange the first layer rope tightly and well with some load (2% of the minimum broken tension of the rope or 10% of rated hoisting load)
- When the tower crane is at the height and below free-standing height, the 6×29 non-rotate hoisting rope can be used; The height of the tower crane greater than free-standing height, the 35W×7 rotate rope suggest to be used.
- Disorderly rope during the service is related to diameter and pre-tightening force of the rope. The rope was pre-tensioned when leave factory. The first layer rope must keep-in, lined up and as much load as possible (2% of minimum breaking load rope or 10% of rated load).
- In order to reduce the probability of mutual extrusion and random rope caused by more layers around the rope, according to the construction progress, use cycle, final height, fall change, life expectancy and other comprehensive conditions, consider the configuration of multiple rope of different lengths, to ensure that the first layer of the drum rope has pre-tightening force. By using short rope in the early stage, the service life of rope can be effectively extended and the service cost of rope can be reduced.
- When the height of the tower crane is low, the length of the rope is suggested to use adopt 4-fall, and the pre-tightening force of the whole length can be satisfied through the load, to prevent the phenomenon of rope sinking and chaos caused by the partial rope not being preloaded.
- After the maximum length of rope is released, the rope on the drum should be retained for at least 3 laps.
- When you need to purchase the rope, it is recommended to use the compacted rope, the detailed scheme please contact our after-sales service;
- The lubrication of the rope also has a certain influence on the arrangement of the rope. The rope should be checked regularly. If the rope is found to have dry grease, it should be removed manually and then smeared with new grease, see Table 6-1.

6.5 Maintenance of safety brake caliper

The safety brake caliper of the tower crane are a one-station, one error structure, that is, the hydraulic pump station provides high-pressure oil for the safety brake caliper, the model of the pump station is YZBS10-20/1A.CP, and the model of the safety brake caliper is SBD240-D.

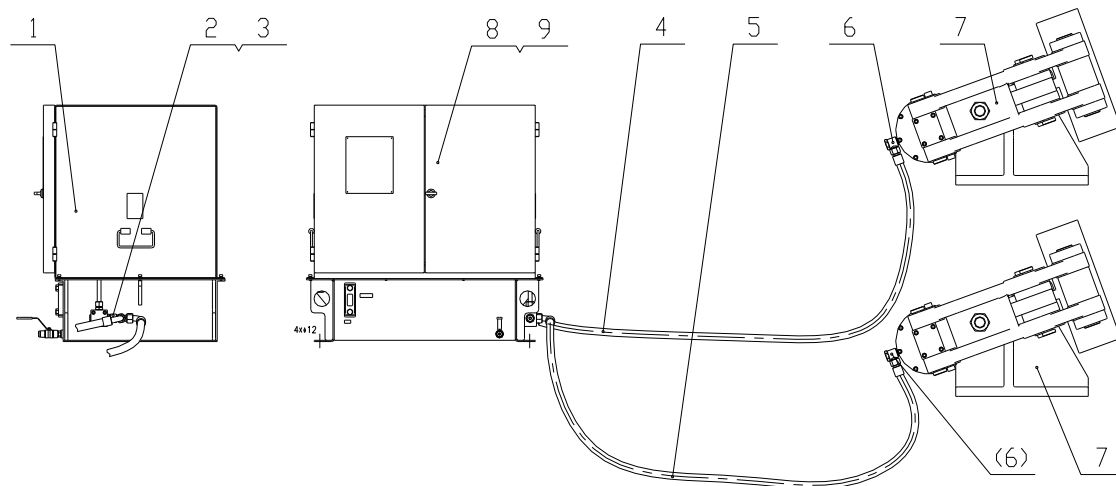


Fig. 6-11 Safety brake caliper

- | | |
|----------------------------|----------------------------------|
| (1) Hydraulic pump station | (2) Sebific duct assembly (3.1m) |
| (3) Clamp of sebific duct | (4) Articulated joint |
| (5) Safety brake caliper | (6) Taper hole plug |
| (7) Pipe end plug | |

6.5.1 Maintenance of YZBS10-20/1A.CP hydraulic pump station

6.5.1.1 Overview

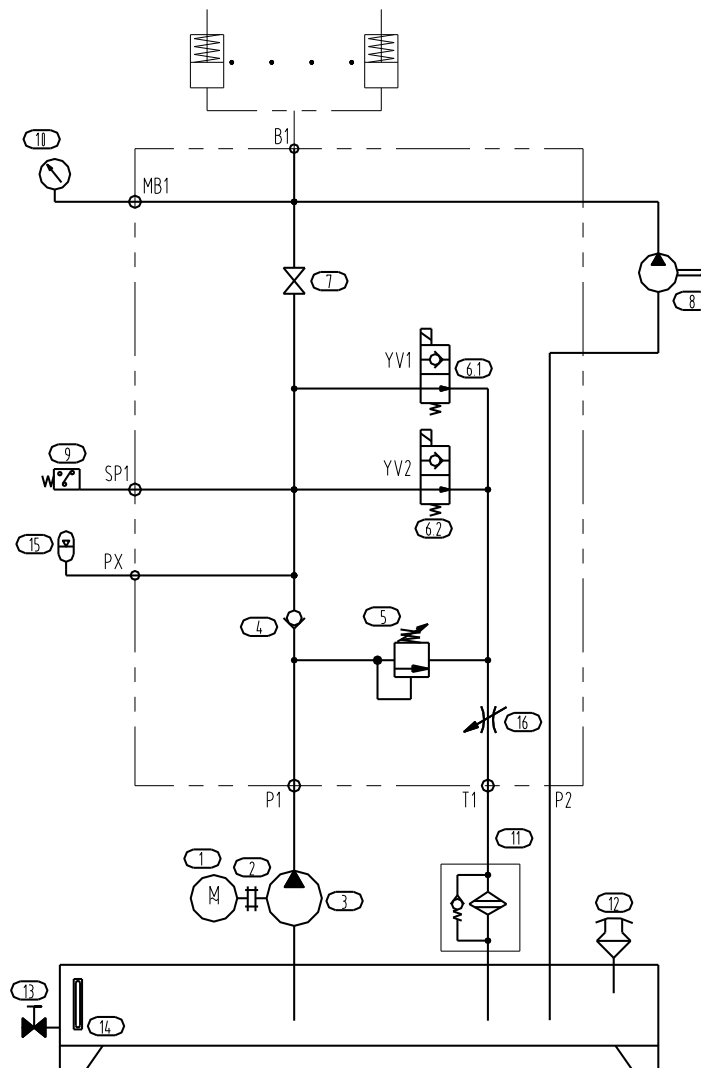
This series of hydraulic station is mainly use for SB series hydraulic clamp disk brake drive and control. It can also be used for the drive control of single acting oil cylinder in other machinery. The system is equipped with deep pressure function and has certain leakage compensation ability. System with manual pump, can be used in emergency power failure.

6.5.1.2 System structure

Hydraulic parameters are shown in Table 8-8, and hydraulic schematic diagrams are shown in figure below:

Table 6-9 Hydraulic station parameters

Parameters Model	Pressure (MPa)	Flow (L/Min)	Motor power (kW)	Oil box volume (L)	Pressure relay setting (bar)	Over flow setting (bar)
YZBS10-20/1A.CP	10	20	4	40	110	120



- | | |
|-----------------------------|-------------------------|
| (1) Motor | (2) Coupling |
| (3) Gear hydraulic | (4) Non-return valve |
| (5) Overflow valve | (6) Magnetic valve 1 |
| (7) Magnetic valve 2 | (8) Stop valve |
| (9) Manual pump | (10) Pressure relay |
| (11) Pressure gage | (12) Return oil filter |
| (13) Air cleaner | (14) Oil drain device |
| (15) Liquid level apparatus | (16) Energy accumulator |
| (17) Throttling valve | |

Fig. 6-12 Hydraulic schematic diagrams

6.5.1.3 Operating principle

1) System control

First of all, when the mechanism needs to work, the main control room closes the control switch of the main gate in the electric control box, and then the motor (1) starts. When the system pressure reaches the high pressure set value of the pressure relay 110bar, the motor stops and the system maintain the pressure. When the system pressure is lower than the set value of about

92bar, the motor starts again.

Opened: When the brake needs to open the main control system for hydraulic station opened electric signals, refer to Fig. 6-12, the magnetic valve (6) obtains electricity; The normally open state into a closed state, the hydraulic oil to the brake cylinder of without spring cavity via non-return valve (4), liquid pressure to overcome the spring force, the opening action, brake output opened signals at the same time to the master control system.

Closing: Refer to Fig 8-12, disconnect the opening signal, magnetic valve (6) power off, from the closed state to normally open state, under the force of the force of the spring in the cylinder without spring chamber flows back to the oil tank through the magnetic valve (6) and the throttling valve (16) to perform close action. The speed of close action can be adjusted by throttling valve (16).



When the mechanism does not work for a long time or under the unoperated state of parking, should be disconnected in the electrical control box of the total network control and opening control, to avoid a long time in the state of pressure, oil leakage caused by frequent motor start and burn!

2) Control

In case of problems or power failure in the system electrical control loop, manual control can be used to open or close the brake, the specific working process is as follows:

Opening the brake: Right-turn to fastening the stop valve (7) to adjust the manual wheel, move the handle of the manual pump (8) up and down, and the pressure oil will be supplied to the brake through manual pump. Observe the reading of the pressure gauge in the system, and stop moving the manual pump (8), the opening action complete.

Closing: Left-turn to loosen the stop valve (7) to adjust the manual wheel, under the force of the spring in the oil cylinder without spring chamber flows back to the tank through magnetic valve (6) and throttling valve (16), perform the closing action. The speed of close action can be adjusted by throttling valve (16).

3) System adjustment

(1) Pressure control of overflow valve

Turn off the power supply of the hydraulic station, tighten the pressure energy appliance (9), adjust the screw for 2-3 turns to increase the pressure of the system's stopping motor, loosen the overflow valve (5) and positive force regulation cap, adjust overflow valve to make the pressure meet the requirements in the Table 6-9. Turn off the power supply of the hydraulic station, adjust one time, and then start it to observe the pressure of the system. If it does not meet the requirements in the Table 6-9. Restore the adjusting screw of the pressure relay, and finally tighten the lock nut on the adjusting rod of the overflow valve.

(2) Electric relay switching pressure adjustment

When the motor is energized, observe the system pressure on from the pressure gauge (refer to the above the table), the switch action of pressure relay shall control the start or stop of motor. If the relay does not switch the pressure correctly, the adjusting screw on the pressure relay shall be powered off to make it conform to the provisions of Table 6-9.

(3) Adjustment of system flow(closing speed)

When the hydraulic station leaves the factory, the throttling valve (16) is fully open. If the closing speed of the safety brake pliers needs to be adjusted on site (it can be slowed down), the adjusting cap of the throttling valve (16) can be rotated clockwise to adjust the closing speed; Conversely, if the closing speed needs to be adjusted back to the original state, only the adjusting cap of the throttling valve to be rotated counterclockwise until the throttling valve is fully opened.

6.5.1.4 Maintenance

Good Maintenance can reduce the failure rate and prolong the service life of the hydraulic station.

1) Preparation before use

- (1) After the installation of the hydraulic connection pipe between the brake and the hydraulic station, the pipe should be cyclic wash, and the connection can be made with the oil outlet of the hydraulic station only after the dye degree of the flushing oil reaches NAS8 level, otherwise the impurities in the pipe may cause serious damage to the hydraulic system;
- (2) Before the first use, the power supply voltage and control signal voltage should be approved to check whether the rotation direction of the motor is correct rotation direction should be clockwise;
- (3) When refueling the tank, the refueling filter device should be used. The refueling volume should be 40L, reaching more than two-thirds of the tank level of the tank. Regularly check the tank level gauge, tank level should not be less than half of the level gauge.

2) Daily inspection

Each 100 to 150 working hours should examine the following items:

- (1) Tank level gauge display;
- (2) Whether the connection of each pipe fittings is loose;
- (3) Whether there is oil leakage;
- (4) Whether the operating sound of motor, pump and valve ground is normal.
- (5) If abnormal, need to make hydraulic station stop working, troubleshooting can be put back into use.

3) Replace hydraulic oil and cleaning system

- (1) The hydraulic oil (ISO46 or ISO32, the details refer to corresponding scutcheon) should be replaced 6 months after the first use of the hydraulic station and the system should be cleaned.
- (2) During normal use, each year to replace at least once a year and a half the hydraulic oil, oil suction filter (depending on the use frequency), oil change should be through the drain valve at the bottom of the tank, drain all the oil tank, and cleared all the impurities on the tank bottom and wall, use the dough or daub glue net angle and underside of tiny particles. Refueling should use refueling filter device to ensure that the tank is clean. The filter state of the refueling filter device should not be less than 20μ, and the oil level should be two-thirds of the level gauge.

6.5.2 Maintenance of SBD240-D safety brake caliper

6.5.2.1 Overview

SBD240-D low speed brake pliers (hereinafter refer to as brake pliers) is a new type of low-speed brake device, which used for emergency safety braking of the main hoisting mechanism and jib luffing mechanism of large and medium-sized cranes. The brake adopts disk spring brake, hydraulic station drive release, compact structure, small maintenance workload, the friction material used does not contain asbestos and other harmful substances, is an efficient emergency brake product.

The structure of the brake sees Fig. 6-13, and other relevant technical parameters are shown in Table 6-11. Its working principle is as follows: The pressure oil in the hydraulic station enters the brake oil cylinder through the control of the magnetic valve. The hydraulic oil further compresses the disk spring and simultaneously pushes the piston rod to drive the two brake tubes to open on both sides, and the braking torque is eliminated. When the magnetic valve is reset the hydraulic station under the action of the spring force, and the spring force is applied to the brake disk by the piston rod through the brake luffing jib, and the specified brake torque is established.

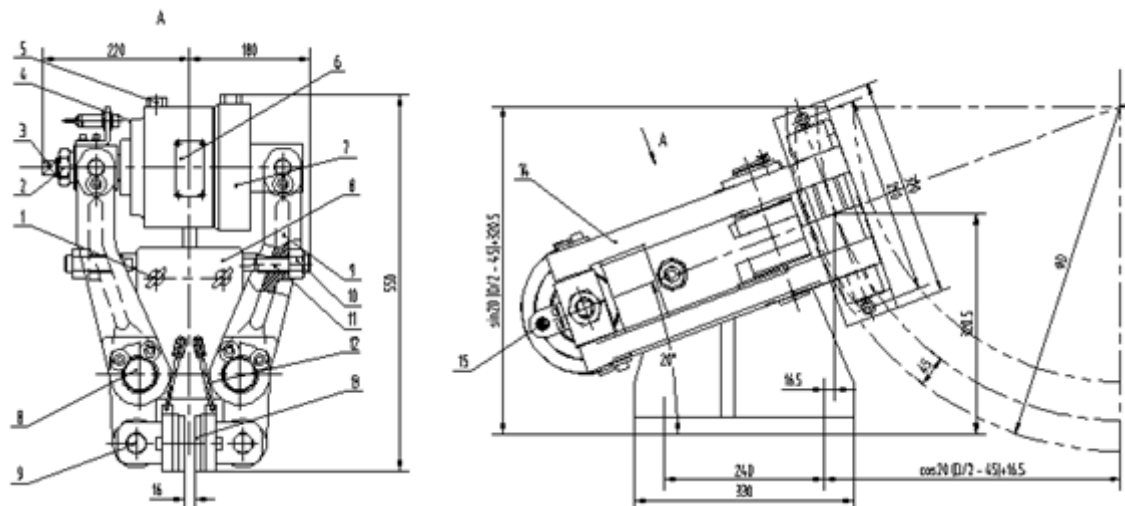


Fig. 6-13 Brake structure

- | | |
|---------------------------|-----------------------------|
| (1) Hoisting ring bolt | (2) Lock nut |
| (3) Brake screw | (4) Limited switch rod |
| (5) Blocking | (6) Scutcheon |
| (7) Hydraulic cylinder | (8) Support |
| (9) Braking luffing jib | (10) Offset locking nut |
| (11) Offset locking screw | (12) Follow position device |
| (13) Braking gaskets | (14) Braking luffing jib |
| (15) Limited switch | |

Table 6-10 Technical parameters of the braking

Model	Rated receding distance for each side (mm)	Rated clamp (kN)	Braking force (kN)	Release (open) pressure (rated/max) (MPa)
SBD240-D	2	240	170	9.5/11.5

6.5.2.2 Installing and adjustment

The brake should be installed correctly, otherwise the designed performance will not be achieved during the work. Therefore, users should strictly follow the methods and steps in the manual when installing and debugging.

1) Preparation before installation

- (1) Before installation, please check whether the brake sign is consistent with the requirements;
- (2) Whether all parts and components of the brake are complete (If there is a hydraulic station, whether all connecting pipe fittings and optional parts are complete);
- (3) All active points are corroded and stuck;
- (4) Whether the braking strap surface is stained with oil, and other impurities affecting the friction performance;
- (5) The surface of the braking disk shall not have rust, oil, welding scars, uneven defects and other defects, it is strictly prohibited to use the brake disk with cracks or other serious defects.

If exceptions are found, the installation can start only after they are rectified.

2) Installing

When hoisting brake, it is strictly prohibited to use the brake cylinder and piston rod (brake screw) parts to hoisting. The mounting support must have sufficient strength and stiffness. Fig 8-14 shows the form and size of the support. The support is directly connected to the bottom seat by bolts.

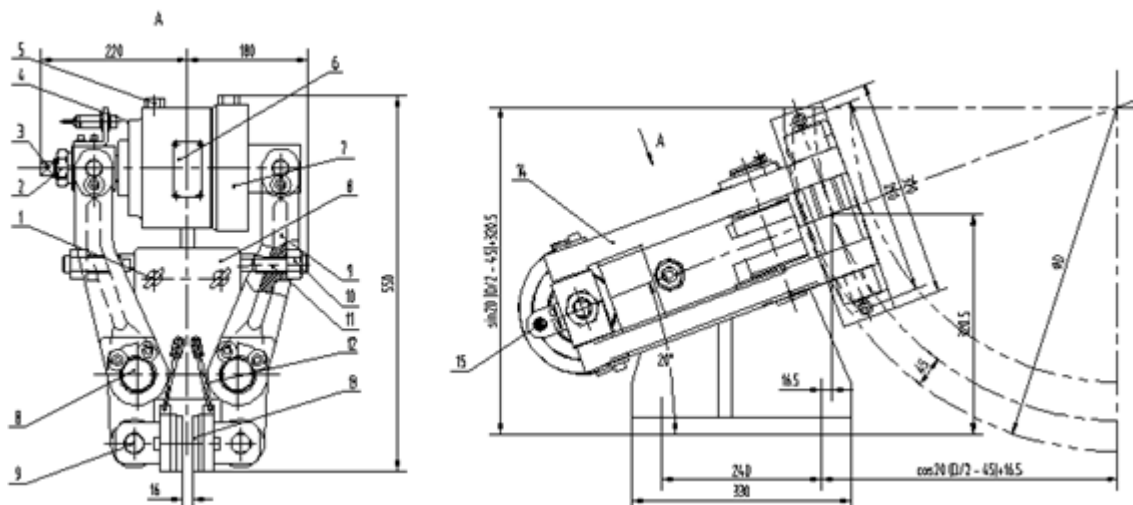


Fig. 6-14 The structure of safety brake (SBD240-D)

The specification, quantity and performance grade of connecting bolts shall comply with the provisions in table below.

Table 6-11 The specification, quantity and performance of bolts

Model	Connection between brake and mounting bracket			
	Specification	Quantity	Performance grade	Moment N.m
SBD240-D	M36	4	≥8.8	1800

The brake shall be installed according to the following steps and methods

- (1) Before installing the brake, the hydraulic station shall be installed in place, the hydraulic pipeline shall be arranged (the length difference between each brake and the hydraulic station shall be minimized), and the electric control circuit shall be connected;
- (2) Connect the brake with the mounting bracket with bolts;
- (3) Ensure that the distance between brake gaskets is more than 3mm from the brake disk thickness;
- (4) Move the installed brake to the installation position of the opened brake smoothly. Please pay attention to whether the brake oil inlet is on one side of the hydraulic pipeline (the brake is generally installed in pairs, and the two-oil inlet are arranged symmetrically). After finding the position, close the brake and hold the brake disk, and then check whether the brake position is correct.



It shall be ensured that the gaskets is parallel to the two sides of the brake disk. If the parallelism cannot be guaranteed, it can be adjusted by the joint surface of the mounting bracket and the brake.

- (5) Connect the hydraulic pipeline with the oil inlet of the brake cylinder. The oil inlet of the brake cylinder is internal thread M18×1.5.
- (6) Connect the travel switch cable (signal indication) according to the requirements of main engine PLC.

3) Adjustment

Various adjustments are mainly carried out during initial assembly (before use) and after replacing a new friction gasket. During the first installation, please make adjustments in the following order.

- (1) Adjustment of shoe backing and clamping force: the size of brake shoe backing (the gap between the brake gaskets and the surface of the brake disk in the released state) will directly affect the size of brake clamping force, which must be adjusted to the specified rated value before use. There is a one-to-one correspondence between the shoe backing, the X value and the clamping force. First, observe whether the dimension X of the brake in the closed state meets the provisions of Table 8-11. If not, please adjust it according to the following methods, and first open the brake (at any time, there are two methods to open the brake).

- ① Power on the hydraulic station to supply pressure oil to open brake;
- ② Operate the manual hydraulic pump (in the hydraulic station) to open the brake (please refer to the instructions of the supporting hydraulic station for relevant instructions); When rotating the adjusting nut in the direction of the brake jib (see Fig. 6-15), X value (setback) decreases, the clamping force increases; otherwise, X value (setback) increases, the clamping force decreases (see Table 6-12 for the rated clamping force of the brake). Close the brake once and observe the X value. If it does not meet the requirements, open the brake again for adjustment. Repeat this process until it meets the requirements. Tighten the lock nut after adjustment.

Table 6-12 The rated shoe backing of brake corresponding X value

Model	Rated shoe backing(mm)	Corresponding X value (mm)
SBD240-D	2	160-0.5



A label indicating the measuring position and measured value is attached to the cylinder near the hydraulic oil inlet. Please refer to it when adjusting.

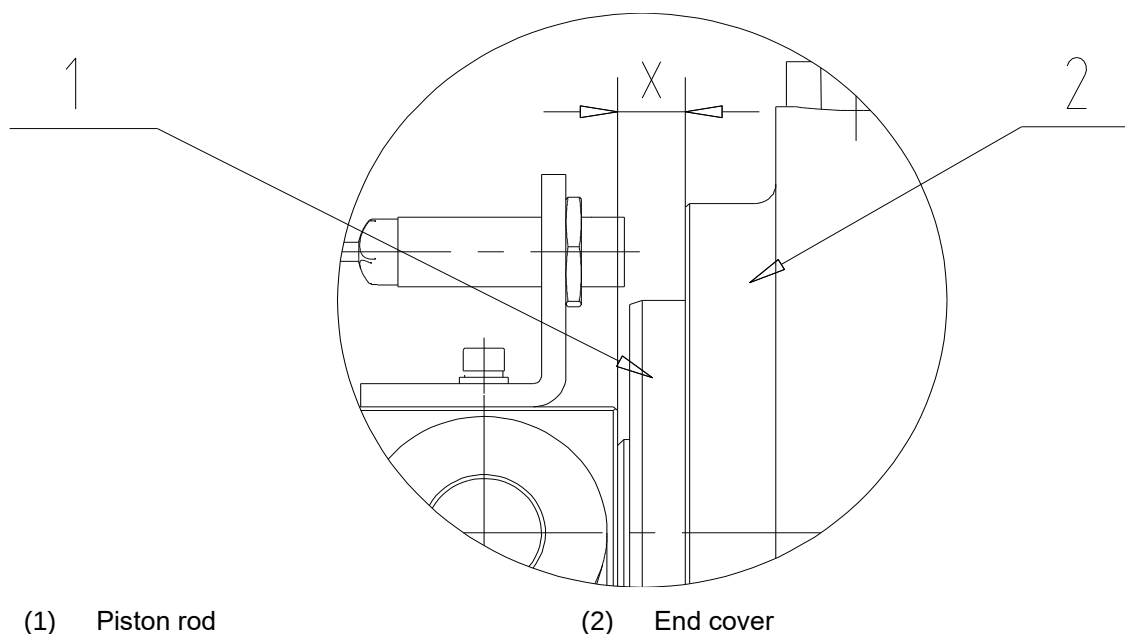


Fig. 6-15 Adjustment of shoe backing

Table 6-13 The rated clamping force and X value

Model of brake	Rated clamping force (KN)	X(mm)
SBD240-D	240	160-0.5

- (2) Brake shoes with bit adjusting, the brake is equipped with a tension spring shoe automatic follow-up device on the two shoes. Before installing the brake, loosen the with bit device screw to make the with bit spring in a relaxed state. After installing the brake, tighten the with bit set screw when the brake is clamped. Generally, the with bit spring does not need to be adjusted during normal operation. If the with bit spring is found to be abnormal during operation, it may be that the with bit spring is loose. As long as the with bit spring is reinstalled or replaced, and adjusted according to the above methods.
- (3) Adjustment of backing equalization: the brake needs to be adjusted during initial installation or after the brake gaskets is worn. During adjustment, release the brake to the normal release state first, and observe whether the clearance between the brake surfaces on both sides and the brake disk rim is consistent. If not, adjust the backing to make it equal. The adjustment method is as follows: first loosen the lock nuts of the backing adjustment devices on both sides, and then screw the adjustment bolts on the side with larger backing inward (Note: at this time, there should be a gap between the adjustment bolts on the other side with smaller backing and the side wall of the base. If there is no gap, loosen the screws on this side first and exit sufficient gap) until the backing on both sides is basically equal (target side) Then screw the adjusting screw on the side with smaller retreat to a distance of 0.2-0.5mm from the side wall of the base, and finally back tighten the locking nuts on both sides.
- (4) Adjustment of release limit switch: each brake is equipped with a travel switch indicating the brake release signal. After all the above adjustments are completed, the travel switch shall be adjusted as follows. Refer to Fig 8-16 to make the brake closed. Measure the distance between the switch head and the sensor with a caliper, which shall be about 3mm. Otherwise, loosen the two bell screws on the switch base (do not remove), Move the switch back and forth to make it meet the requirements, and repeat the closing and releasing action of the brake for many times. After the switch signal is stable, tighten the locking screw.

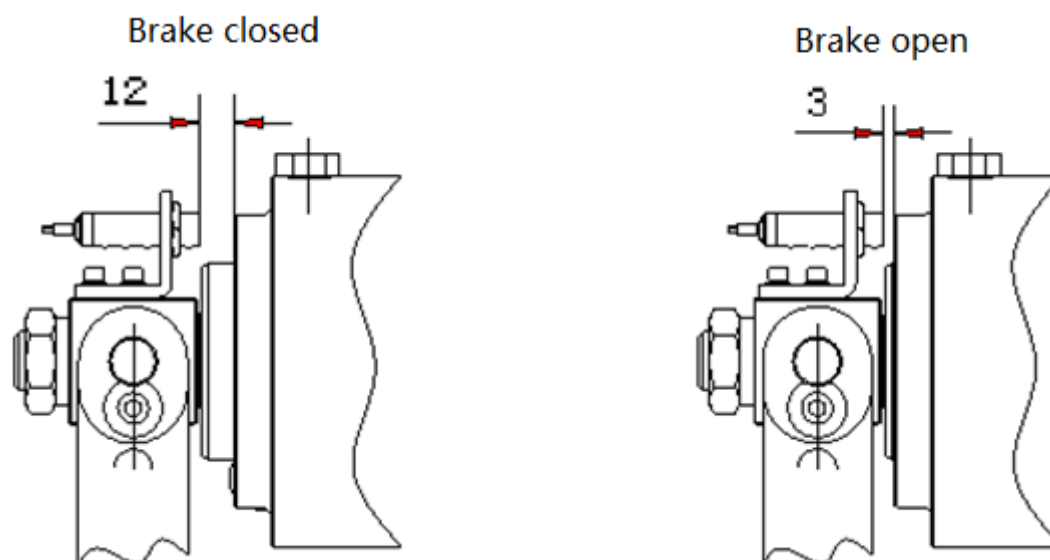


Fig. 6-16 Adjustment of travel switch

6.5.2.3 Use and Maintenance

1) Use

Before using the brake, please check as follows. After checking that everything is normal, it can be put into use

- (1) Whether the brake is installed correctly and meets the requirements
- (2) Whether all adjustments meet the technical requirements,
- (3) Whether the brake gaskets and brake disk surface are clean and free of oil
- (4) Whether the paint is damaged. If it is damaged, it must be repaired. During paint repair, the following parts shall not be polluted: each hinge point, brake pad, brake disk, brake surface and shaft surface.

2) Maintenance

The brake shall be inspected every 7-10 days (depending on the actual situation), and the inspection items are as follows:

- (1) Check whether the disk spring is broken or the hydraulic oil leaks to the disk spring from the observation window of the brake hydraulic cylinder. If the disk spring is broken or leaks oil, it must be replaced with new parts or repaired (the brake hydraulic cylinder is optimized, and the theoretical working life can reach 500000 times)
- (2) Remove the brake hydraulic pressure cylinder as follows: first open the brake, loosen the adjusting nut (at least 10mm), remove the lock nut, and then close the brake (this can eliminate the spring force) , remove the connected hydraulic pipeline, remove the connecting pin on the support at the rear of the oil cylinder, and then remove the hydraulic cylinder. The installation of the new hydraulic cylinder can be carried out in the reverse order. After replacing the new hydraulic cylinder, it needs to be adjusted again, and it can be put into use after adjustment;
- (3) Check whether the stroke limit switch bumper is loose and the action is correct
- (4) Whether the dimension X becomes longer due to the wear of the gasket. If it becomes longer, the clamping force decreases and must be adjusted to the specified value.



Hydraulic cylinder internal structure is special, and contains proprietary connection technology, do not disassemble, but should consult us, in order to prevent disk spring collapse out of injury!

We recommend replacing the faulty hydraulic cylinder as a whole, and shipping the replaced hydraulic cylinder back to our company for maintenance!



The brake gaskets have certain weight, please be careful when replacing it, which may cause personal injury. When replacing the brake gaskets, ensure that the brake is in open state, and there is no possibility of sudden closure.

6.5.2.4 Common fault analysis and troubleshooting

1) No action (no release) after sending power on command to the brake

- (1) The magnetic valve of the driving hydraulic station cannot be energized due to line or control failure. Check the line or control system level by level and eliminate relevant faults
- (2) If the control magnetic valve coil is open circuit, resulting in the magnetic valve not acting, use a multimeter to measure and confirm whether the coil is open circuit. If it is open circuit, replace the magnetic valve coil with a new one
- (3) The set pressure of the overflow valve is too low to open the brake. Observe the reading on the pressure gauge on the hydraulic station to see whether it is consistent with the release pressure indicated on the brake label. If it is lower than the specified value, the system pressure shall be adjusted to the required pressure according to the operating manual of the hydraulic station
- (4) If the motor is burnt out, use multimeter and other tools to detect the motor. If the motor is damaged, replace the motor of corresponding specification and model
- (5) The hydraulic oil is not suitable for the local ambient temperature, so that the oil pump cannot absorb oil. Replace the hydraulic oil of corresponding specifications, L-HM46 or DTE25 hydraulic oil is recommended when the ambient temperature is 0 ~ +30°C; L-HV32 or L-HS low-temperature hydraulic oil is recommended when the ambient temperature is -20 ~ +250°C.

Fault prevention measures

Keep the relevant control circuit components in good condition. It is best to set overvoltage protection for the motor and magnetic valve coil to prevent instantaneous overvoltage from burning the coil, keep the hydraulic oil clean, and do not adjust at will when all parts and components on the hydraulic station work normally

2) The retreating distance on both sides is not equal, and one side will float on the brake disk

- (1) There is a serious deflection in the installation of the brake, so that the center of the brake is biased to one side (installation error). Correct the transition connecting plate or add an adjusting pad between the installation support and the transition connecting plate for adjustment;
- (2) If the adjustment is improper during installation, it can be adjusted according to the above method

3) Travel switch action fault

- (1) If the distance is not adjusted properly, adjust the position of the limit switch drum and the ejector rod to the appropriate position;
- (2) The hydraulic oil cannot be suitable for seasonal replacement. The hydraulic oil becomes cold due to the weather, the viscosity increases, and the brake cannot be fully opened in place. The hydraulic oil shall be replaced in time or the system pressure of the hydraulic station shall be properly adjusted (not higher than 1.3 times of the rated working pressure).

4) Preventive measures

Correct adjustment during installation, pay attention to whether the mandrill rod is loose during inspection, and select hydraulic oil suitable for local working environment.

6.5.2.5 Spare parts list

Table 6-14 List of main purchased parts

No.	Definition	Model	Qty.	Note
1	Brake liner	ZW495.2	2	Self-made
2	Inductive switch	Bi5-M18-AZ3X	1	Truck
3	Dust-proof ring	Dust-proof ring AF2 120	1	Ocon
4	U-seal	AU3 120135U	1	Ocon
5	Guidance tape	379/9.7X2.5 (BS50704)	1	Ocon
6	Si'Te seal	120X135.1X6.3 (AS1301200)	1	Ocon
7	Guidance tape	565/9.7X2.5 (BS50704)	1	Ocon
8	U-seal	AU1 180200U	1	Ocon
9	O-ring	178×1.5 (Inner diameter × wire diameter)	1	/
10	O-ring	∅ 40×3.5 (Inner diameter × wire diameter)	1	/
11	Si'Te seal	180×195.1×6.3 (AS1301800)	1	Ocon

6.5.3 Installation and Maintenances of Proximity Switch

6.5.3.1 Installation of Proximity Switch

The installation diagram of proximity switch is shown in Fig. 6-17:

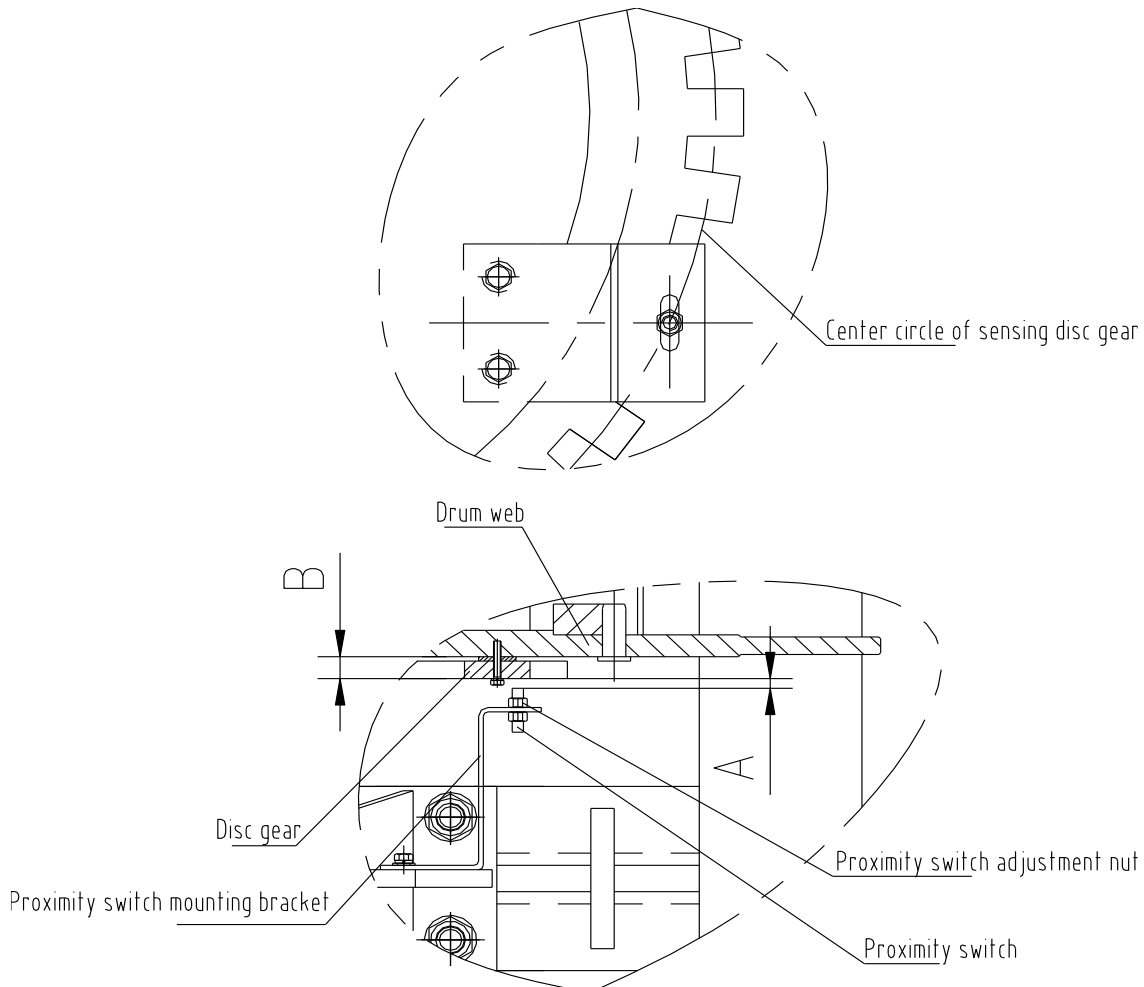


Fig. 6-17 Installation Diagram of Proximity Switch

The installation requirements of proximity switch are as below:

- 1) Adjust the double nut on the proximity switch to make the distance between induction end of the proximity switch and the convex of disc gear to be 8mm, the check distance of the proximity switch to be 10mm, and the fixing position of the proximity switch to the check position to be 12mm (refer to Fig. 6-17);
- 2) The distance B from convex of disc gear to baseplate (End plate of drum) is 27mm (the width of disc gear is 12mm, the width of pad is 15mm);
- 3) The minimum distance between the proximity switch fixing position and drum plane is 57mm (12mm+10mm+8mm+27mm), the maximum distance can't be over than 62mm.

6.5.3.2 Maintenance of Proximity Switch

The hoisting mechanism (H110FL100-1110D(415V/50Hz)) of T1200-64Q tower crane is fitted with a safety brake directly applied on the drum and controlled by proximity (over-speed protection) switch. When the drum speed exceeds the maximum design speed, the proximity (over-speed protection) switch for measurement of drum speed sends a signal and the control system sends a power-off command so that the safety brake is powered off to close, in order to prevent the safety accidents due to extreme conditions such as failure of main brake and breakage of drive chain.

The maximum speeds of drums for luffing mechanism and hoisting mechanism and the corresponding recommended actuation settings of over-speed protection switches are listed in Table 6-15:

Table 6-15 Maximum Speed of Drums for Mechanisms and Recommended Actuation Settings of Over-Speed Protection Switches

Mechanism model	Maximum drum speed (r/min)	Speed setting of over-speed protection (r/min)
H110FL100-1110D (415V/50Hz)	79.3	89

6.6 Trolley mechanism

6.6.1 Overview

The structure of the trolley mechanism is shown in the figure below which layout as “—” type. The three-phase asynchronous frequency motor with axial flow fan. The electromagnetic brake installed at the empennage of the motor. Planetary reducer which motor output torque to reducer through coupling. The reducer output end flange connected to drum by bolt.

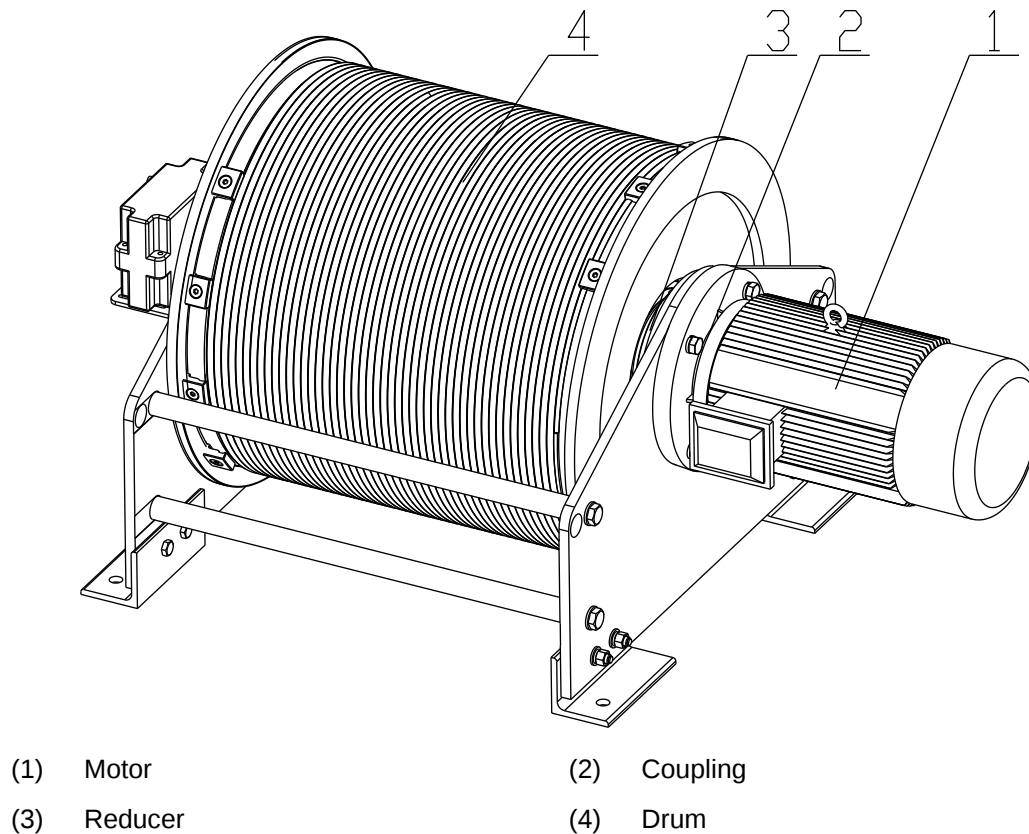


Fig. 6-18 Structure of the trolley mechanism

6.6.2 Trolley brake

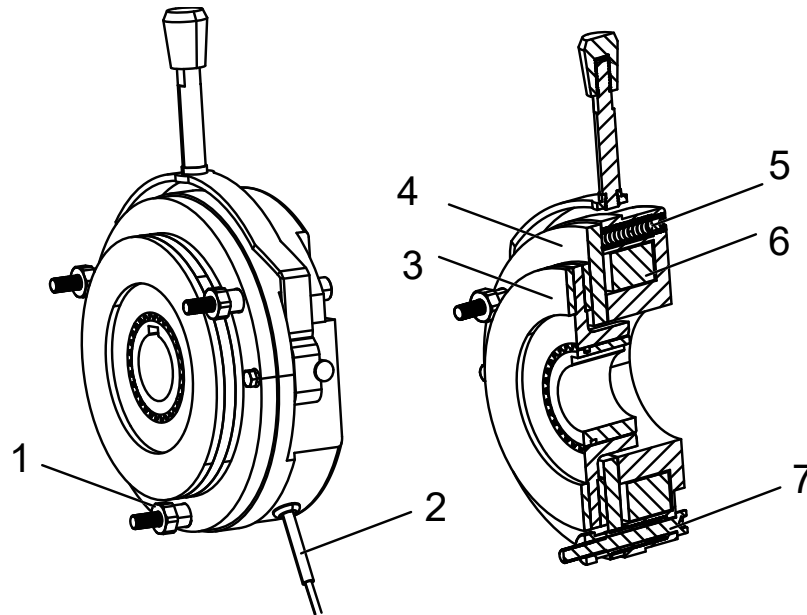


Fig. 6-19 Trolley brake

- | | |
|----------------------------|--------------------|
| (1) Brake disk | (2) Hollow bolt |
| (3) Armature iron | (4) Mounting screw |
| (5) Magnetic yoke assembly | (6) Spring |
| (7) Fixture wire | |

6.6.2.1 The apply and release of brake

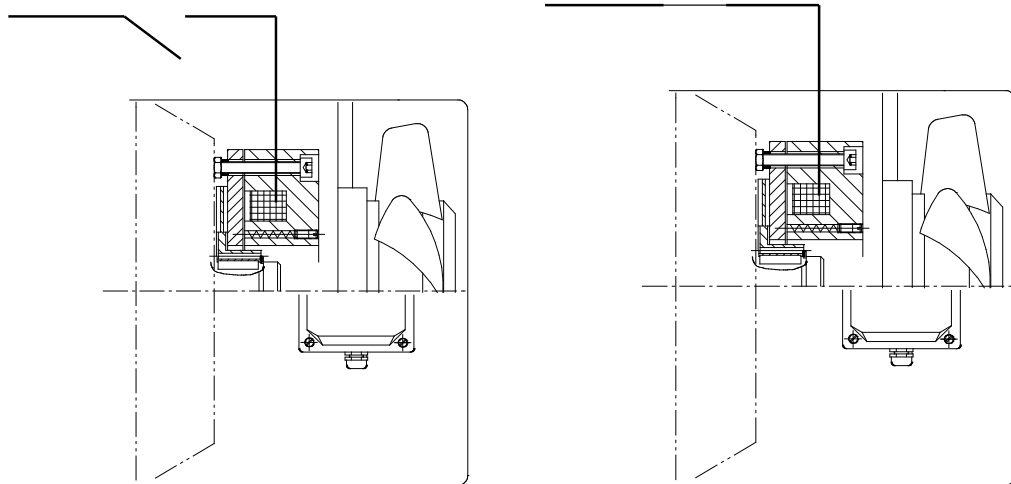


Fig. 6-20a Apply the electromagnetic brake Fig. 6-20 b Release the electromagnetic brake

Fig. 6-20 Apply and release state

6.6.2.2 Maintenance

- Maintain once for every 450 hours or three months.
- Adjust the air gap: the standard air gap value $\delta=0.6\text{mm}$ for the electromagnetic (2) brake of three-phase asynchronous motor. See Fig. 6-21.

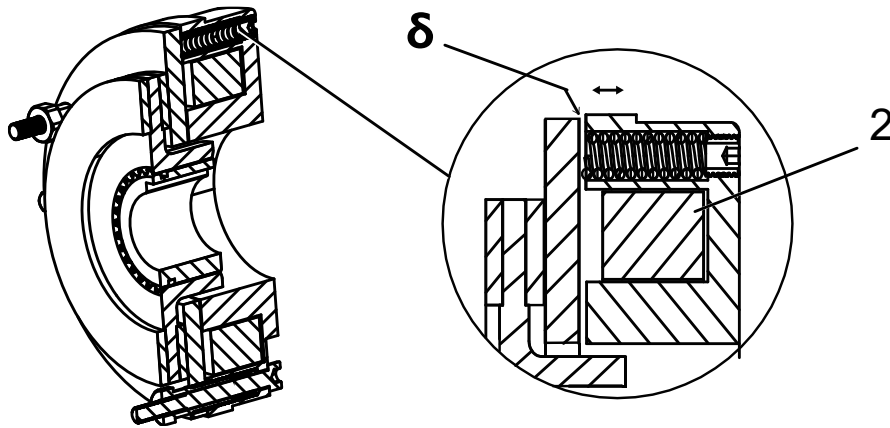


Fig. 6-21 Adjust the air gap



Ensure that there are no sundries (for example: concrete, sand, or grease) in the electromagnetism brake.

6.6.2.3 Adjust the air gap of the trolley travel gear brake

Ensure the main motor and brake are power-off!

The normal working air gap of the brake is 0.6mm, maximum gap is 1.2mm. If check out the brake is not working or the air gap over the maximum gap value the brake need to adjust.

- 1) See Fig. 6-22 loosen the retaining bolts ① and remove the fan cover ②;
- 2) See Fig. 6-22 loosen the installing screw ③ and then adjust the hollow nut ④ to the proper position until the gap value is 0.6mm, and then tighten screw ③.

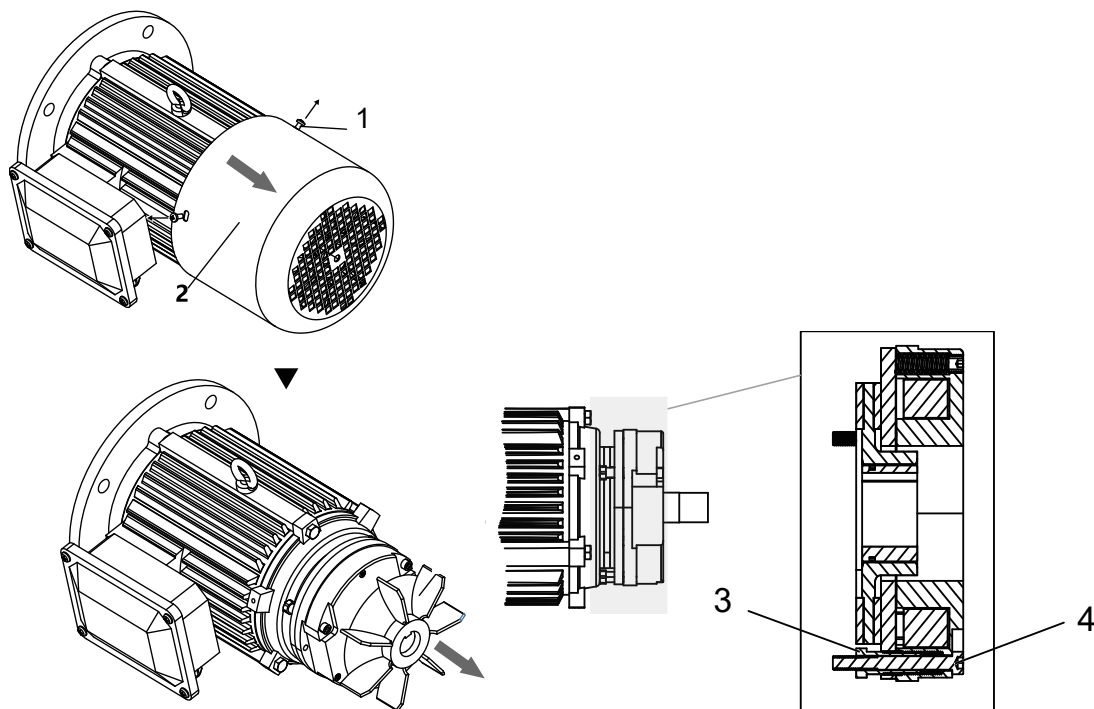


Fig. 6-22

- 3) See Fig. 6-23, install the fan cover ② and tighten the retaining bolts ①.

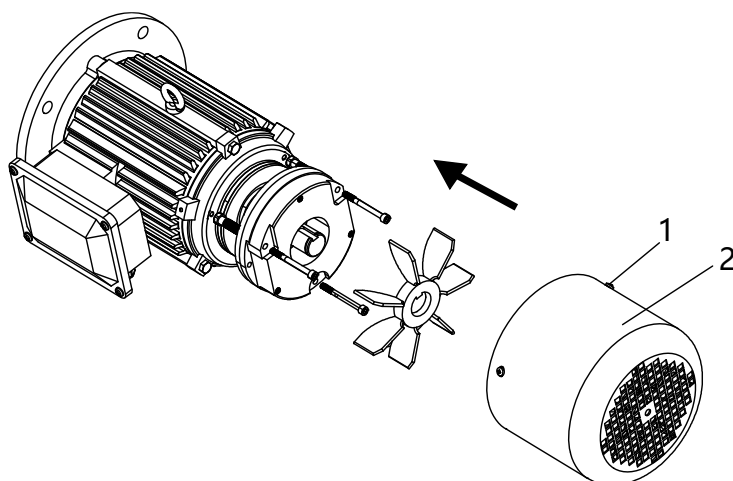


Fig. 6-23



If the air gap is not appropriate, repeat the step 2 and adjust it to 0.6 mm, it should be consistent in all directions.

6.6.2.4 Replace the brake friction plate

When single side of friction plate wear close to the metal end brake disk about 2mm, must replace friction plate. Make sure the motor and brake at the blackout state, step as following:

- See Fig. 6-24a, loosen the retaining bolts ① and remove the fan cover ②;
- See Fig. 6-24b, loosen the fixing screws ⑤, and remove the brake ⑥.
- See Fig. 6-24c, Remove the Retainer ring⑦, pull out of the brake disk and the splinted sleeve⑧

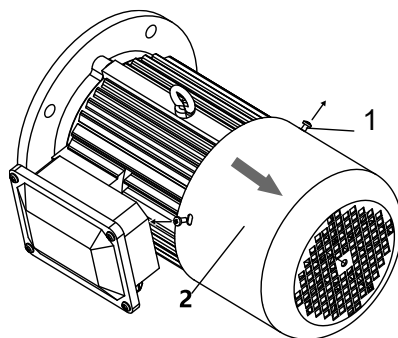


Fig. 6-24a

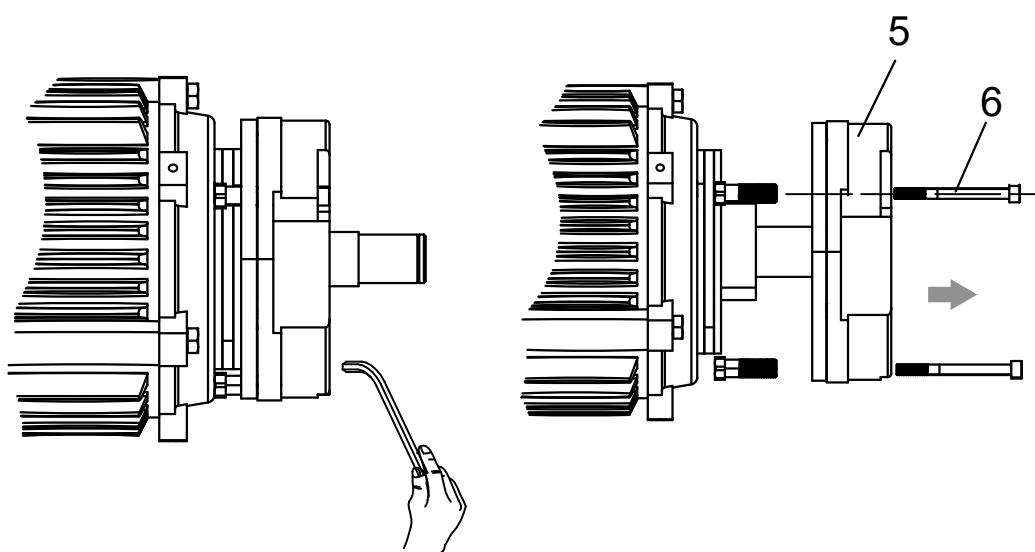


Fig. 6-24b

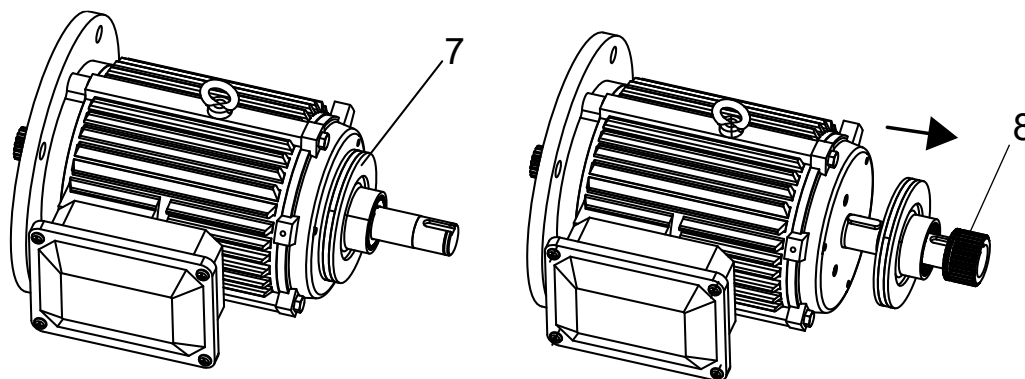


Fig. 6-24c

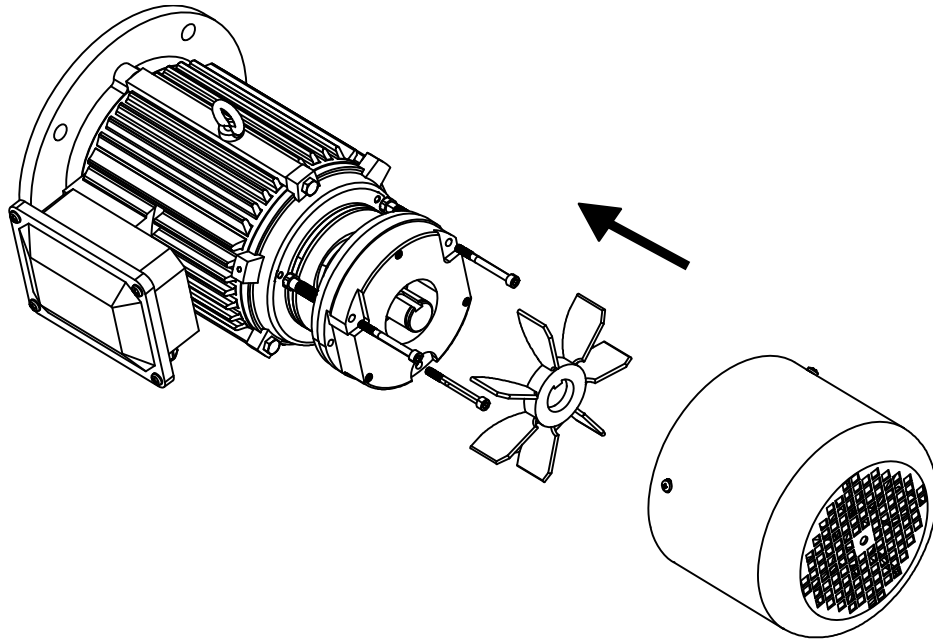


Fig. 6-24 Replace friction plate

- install new brake disk and splined sleeve and fit the Retainer ring;
- install the brake and the mounting bolts (adjust the air gap according to *Section 6.6.2.3*)
- install the fan cover and tighten the retaining bolts.

6.6.3 Maintenance of trolley reducer

6.6.3.1 Maintenance period

Refer to the **Section 6.4.4**.

6.6.3.2 Adding oil

The structure of the reducer is shown in the figure below.

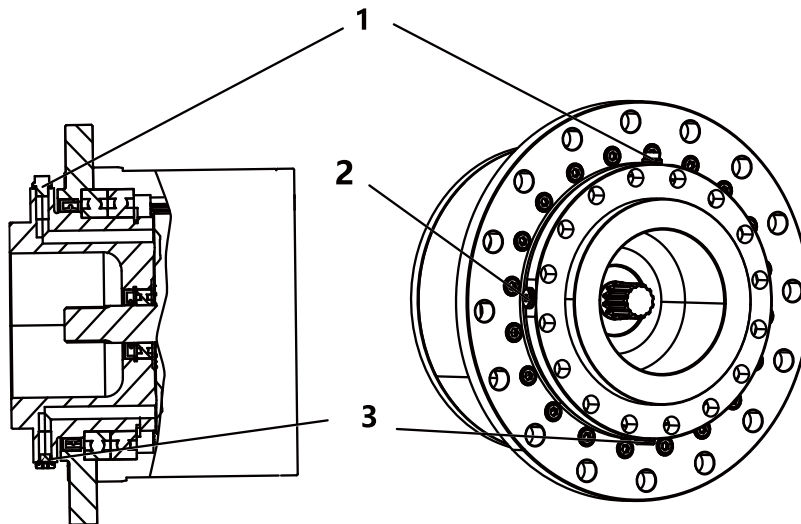


Fig. 6-25 Structure of the trolley mechanism reducer

- (1) Oil hole
- (2) Oil hole
- (3) Oil hole (connecting to oil output tube)

Oil adding steps:

- a) Change the oil plug of hole (2) to a vent cap, prepare the specified oil (it is forbidden to mix different lubricants with each other)
- b) Open the vent cap of the oil plug first, and then the oil plug of hole, expel all the waste oil inside, then insert the oil plug;
- c) Open the oil plugs of hole (1) and (2), add oil to the reducer
- d) Tighten the oil plugs of hole and vent cap, ensure water can't get in the holes.



- (1) Ensure the gear oil has cool down to the surrounding temperature before adding or replacing oil, otherwise the operator can be scalded.
- (2) The rubber slice in the reducer vent cap shall be remove after install mechanism.

6.6.4 Maintenance of trolley motor

6.6.4.1 The storage of motor

- The motor should be stored in dry and ventilative places and covered by waterproof cloth. Keep the motor clean, and no droplet, greasy dirt, dust or erosion gas could be get into it. Clean the inside and outside of the motor regularly.
- As for motors that have been stored for more than one year, clean the inside of it and dry the inner water. Daub clean antirust oil on the bearings, all the matching surfaces and fasteners with thread(except for grounded bolt).
- The covers, covers of connecting box and unused outlets on the end cover should be covered soundly to avoid water, dust, oil or grease getting into the motor. Watch out for mouse.

6.6.4.2 Maintenance for motor before reusing

- As for motors that have been stored for more than one year, check whether there is rust in bearings and the location of bearings. If rust exist, exchange bearings immediately. Clean and refuel the bearings before restarting to avoid damages or noise caused by dried grease.
- Check whether the assemble is integrated, or whether the fasteners are tight. If there are dust or foreign materials inside, please clean up and use dry compressed air when necessary.
- If the mechanism is left unused for a long time, the exposed parts of the motor should be kept dust-free and dry. When it is to use again, perform mechanical check before installation. Check whether the assemble is integrated, or whether the fasteners are tight. If there are dust or foreign materials inside, please clean up and use dry compressed air when necessary. Measuring the insulation resistance between stator winding and shell with 500V Megohmmeter before using. When the figure is less than 0.5 megohm, the motor should be withered and the drying treatment could be performed by bubbling low pressure air into the winding (the temperature should not be more than 125°C). To avoid motor rusty, it is recommended to daub anticorrosive oil on the matching surface and fasteners with thread(except for grounding bolts) during installing. Also, all the fasteners should be with spring washer to avoid automatic relaxation. After installation, turn the rotor manually and it could rotate freely with no friction.
- After installation, check whether the brake could close firmly or release. After energizing, the rotor of the motor could be rotated elastically by hand.
- When install gear or coupling, clear the rust on the shaft first. Heavy strike should be forbidden to avoid damages to the bearings
- The connection box is equipped with grounding bolts which should be grounded reliably after installation.
- The method of connection of motor should be exactly the same with the requirements offered in this technical file, or abnormal operation or even overburn will occur.
- After installation of motor, it should run 30~40 minutes without load. If the condition is well, then add load and watch out for the stability of power. When deviation between the voltage of power(the frequency is rated) and rated voltage is no more than $\pm 5\%$; or positive deviation occurs both for voltage and frequency and the sum total of them is no more than

6%; or negative deviation occurs both for voltage and frequency or one is positive and the other is negative, and the total sum of them of absolute value is no more than 5%, the motor is allowed to operate in rated condition.

6.7 Slewing mechanism

6.7.1 Overview

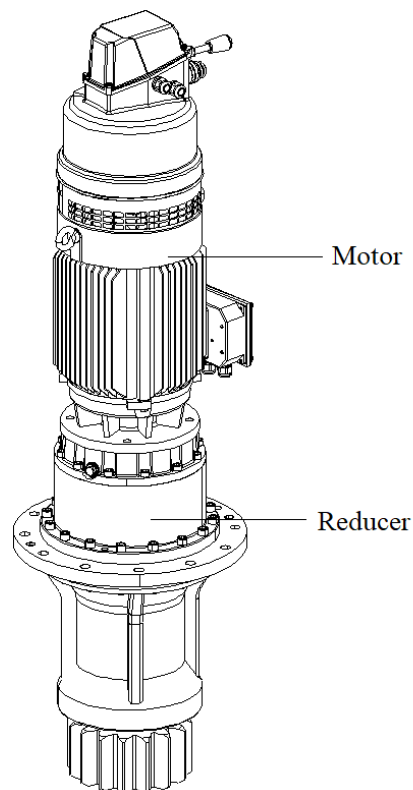


Fig. 6-26 Sketch of slewing mechanism structure

Motor connects to reducer spline. Reducer flange install on the turntable, reducer output gear driven the slewing ring. The layout of slewing mechanism depends on the model, with single or double slewing, etc.

The braking model of the slewing mechanism is normally closed braking with weathervane. The motor and reducer of slewing mechanism should be checked and lubricated regularly according to the requirements of the **Section 6.1** and the **Section 6.3**.

6.7.2 Slewing brake

Slewing motor brake configure with weathervane which consist of brake and electrical weathervane; The brake can be released electrically or manual by electric weathervane. The moment of brake is **80N·m**.

Slewing brake can be divided into two type of structural arrangement. The follow-up will respectively describe the clearance adjustment and maintenance of the two kinds of brakes.

6.7.2.1 Working principle

The slewing brake is an electromagnetic brake, which will be applied once the power supply is cut off. See Fig. 6-27

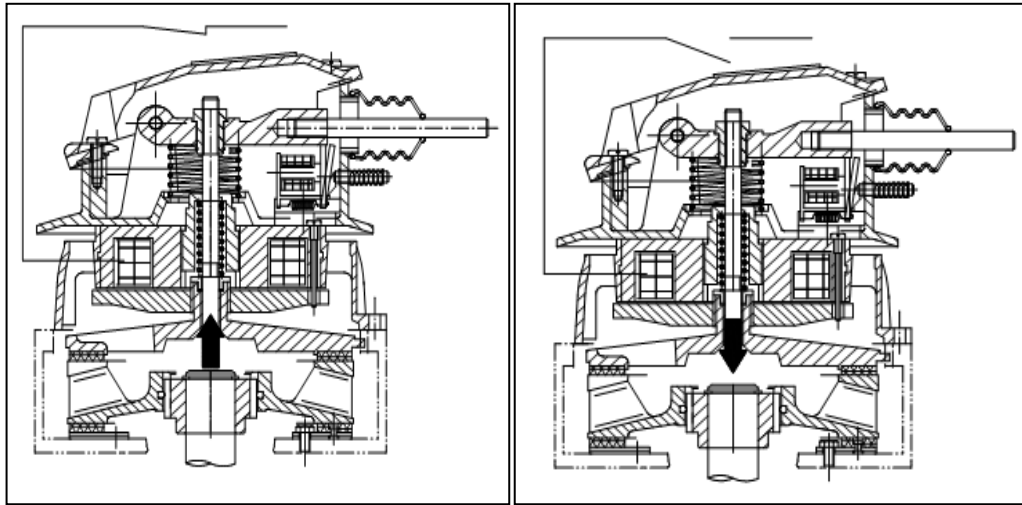


Fig. 6-27a Brake released

Fig. 6-27b Brake applied

Fig. 6-27 Working state of brake

6.7.2.2 Electric release and Manual release

■ Electric release:

First, the brake excitation iron core is fed with specified DC current, and then the weathervane electromagnet is fed with specified DC current, and then the weathervane armature is close., and then the DC current of the brake electromagnet should be disconnected. At this time, the armature of the weathervane supports the weathervane release rod, so that the friction disc connected by the release screw and the weathervane release rod cannot move towards the brake disc, the brake disc is in the release state. Finally, the DC current of the weathervane electromagnet should be disconnected in time. At this point, the electric release of the brake is completed.

■ Manual release of vane Brake:

First move the electric weathervane release handle to the tail of the motor, then push the weathervane push handle inward to make the armature hold the weathervane release lever, and finally release the weathervane push handle, to achieve the manual release function of the weathervane brake

6.7.2.3 Clearance adjustment and maintenance (1)

For conventional brake structure as shown in Fig. 6-28, brake friction plate (13) after long-term use of friction losses, armature (10) and field core (9) increase the air gap δ , brake spring (16) length increases, reduce the braking moment, because the air gap δ may increase at the same time, the armature (10) have difficult in actuation, serious will not be able to actuation, result the motor in braking state, and then the motor burnout. There before, it is necessary to check the air gap δ value frequently. When the static braking moment is less than the stipulate value or greater than 1.2mm, the δ should be adjusted in time. And if the friction plate (13) is worn to close to its steel mail, the friction plate (13) should be replaced in time.

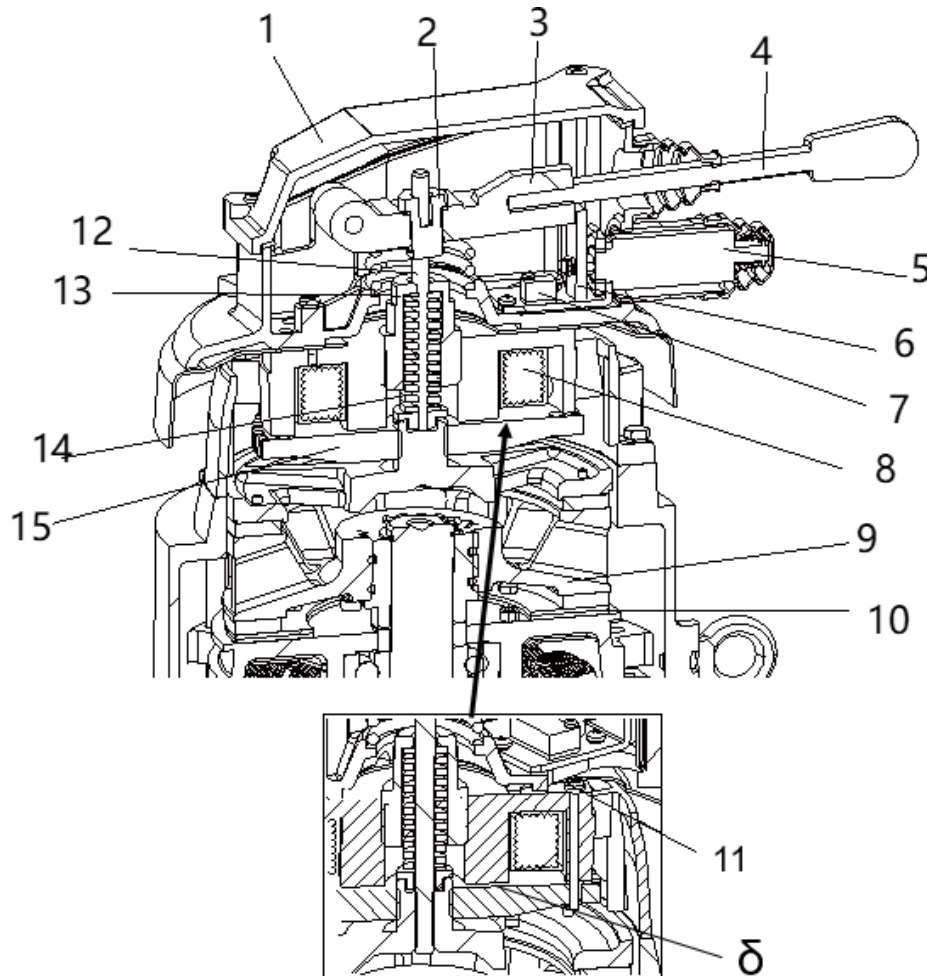


Fig. 6-28 Brake structure

- | | |
|---------------------|---------------------|
| (1) Cover | (2) Adjust nut |
| (3) Release rod | (4) Release handle |
| (5) Push handle | (6) Armature |
| (7) Electromagnet | (8) Field core |
| (9) Friction disk | (10) Friction piece |
| (11) Locating screw | (12) Release screw |
| (13) Spring chamber | (14) Braking spring |
| (15) Armature | |

■ Regular inspection

Regular inspection once for every 3 months, do not remove any parts, the braking opening, braking should be metal impact sound; When the motor is running, the brake should have no abnormal sound (friction, metal impact) and vibration.

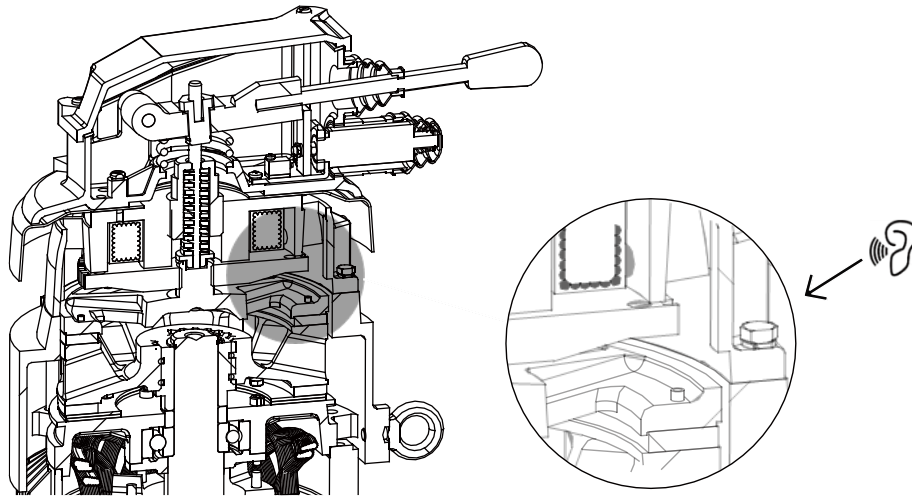


Fig. 6-29

■ Regular adjust

Once every 3 months, remove the weathervane cover. Flat mouth screwdriver loosens the positioning screw and counterclockwise moving armature pull cylindrical gear, let the armature against field core, to promote the positioning screw, make its end stick close with armature ends, at the same time with a flat mouth screwdriver clockwise slowly moving armature pull cylindrical gear, when the end of the armature fifth hole through the end of the positioning screw, insert and tighten the set screw on moving (the clearance values δ : 0.75~1.0mm). When the brake is opened and braking, the action should be sensitive and there should be obvious metal impact. When the motor is running, the brake has no abnormal sound (rubbing sound, metal impact sound) and action. As shown in Fig. behind.

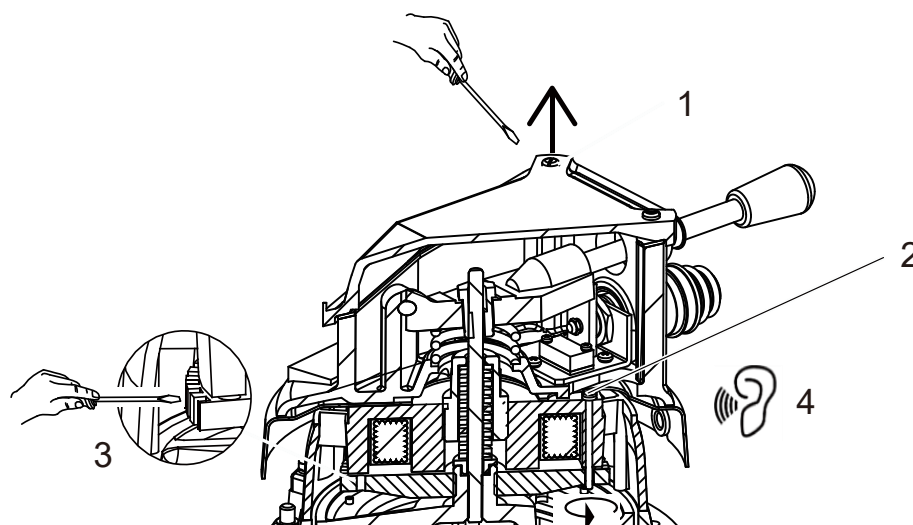


Fig. 6-30

■ Regular dismantling and check

Once every 6 months, remove the whole lower vane brake and check the friction plate (13). When its thickness (a) is less than 3mm, the friction plate must be replaced. Install the whole windward marker brake, and adjust the clearance δ value according to the regular debugging requirements. As shown in Fig. behind.

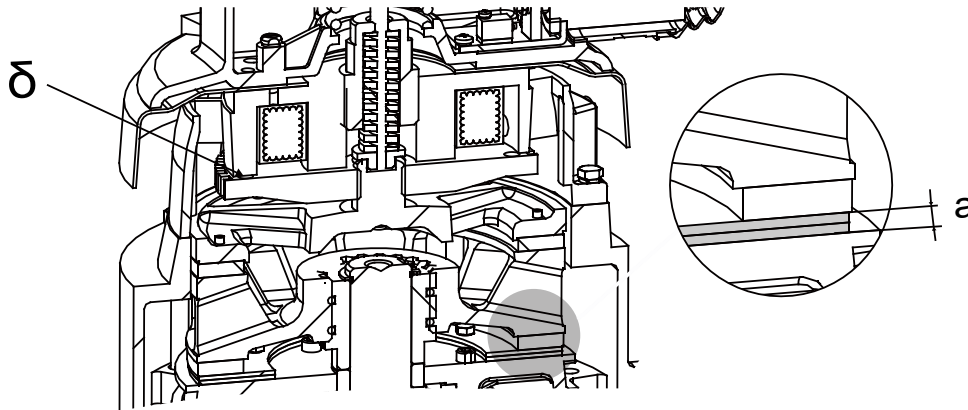


Fig. 6-31

■ Replace steps of brake friction disk

- 1) Put the tower crane in the safe state, ensure will not happen any accident when Dismantling motor operation, otherwise the following operations were prohibit !
- 2) Cut off all power;
- 3) Dismantling electrical weather vane;
- 4) Unscrew locating screw (8);
- 5) Unscrew the spring chamber (15), take out the brake spring (16), unscrew the mounting screw of the exciting iron core (9), carefully remove the exciting iron core (pay attention to protecting the exciting iron core lead), remove the friction disc (11) and brake disc (12), and check the friction disk mounted on the cover frame (14) and the friction disk respectively. The friction plate on (11) if the friction plate is seriously worn, it should be replaced immediately (13), remove the worn friction plate (13) and install a new;
- 6) Remove the worn friction plate and install a new one;
- 7) Reinstall the removed parts in the reverse order, and adjust the brake gap δ according to the second (regular debugging), and adjust the electric weathervane according to the fifth (adjustment steps of the electric weathervane).

■ Adjustment steps of electric weathervane

- 1) Disconnect all power supplies, and adjust the brake gap δ according to the second (regular debugging);
- 2) Put the motor under braking state (weathervane release lever (3) can move downwards freely);
- 3) Hold down the weathervane release handle (4), and slightly loosen the adjusting nut (2) in a counterclockwise direction, so that the weathervane armature (5) emerges about 1mm below the weathervane release lever (3);

- 4) Release the electric weathervane by sounding to see if the action is normal. If the weathervane armature (5) is blocked from free movement under the weathervane release lever (3), the adjusting nut (2) should be loosened again at this time, if the weathervane armature (5) If the weathervane release lever (3) cannot be supported, the adjusting nut (2) should be properly tightened;
- 5) Manual and electric release several times, and then close the weathervane cover after the action is normal.



- *Check whether the weathervane is working properly, and readjust if necessary. When the gap value is greater than 1.2mm, the gap value should be adjusted in time, and the recommended gap value is about 0.8mm;*
- *When the thickness of the friction plate is less than 3mm, the friction plate should be replaced in time;*
- *The adjusted electromagnetic brake and electric weathervane should be checked if the manual release function, electric release function and braking function are normal, and they can be put into use after being normal.*
- *The electromagnet of the electric weathervane cannot be energized for a long time, otherwise it will burn the electric weathervane electromagnet.*
- *When the motor is working normally. The electric release action of the electric weathervane cannot be used, otherwise it will cause the motor brake to work abnormally, which will affect the safety of the tower crane in severe cases.*

6.7.2.4 Clearance adjustment and maintenance (2)

Lay out of new designed slewing motor as shown the following Fig. 6-32.

Adjustment steps of electromagnetic brake

After long-term use and wear of the brake friction plate, the gap between the armature and the excitation magnet core increases, the length of the brake spring increases, and the braking torque is reduced. At the same time, due to the enlarged gap, it is difficult for the armature to pull in. In severe cases, it cannot be pulled in, causing the motor to be in a braking state, and even the motor is burned out. When the static braking torque is less than the specified value or the gap is greater than 1.2mm, it should be adjusted in time. When the thickness of one side of the integral friction disc is less than 2.0mm, it should be replaced in time.

The adjustment steps of electromagnetic brake gap can be divided into: adjust the gap between static core and moving plate; adjust the gap between bottom plate of loose brake and contact plate.

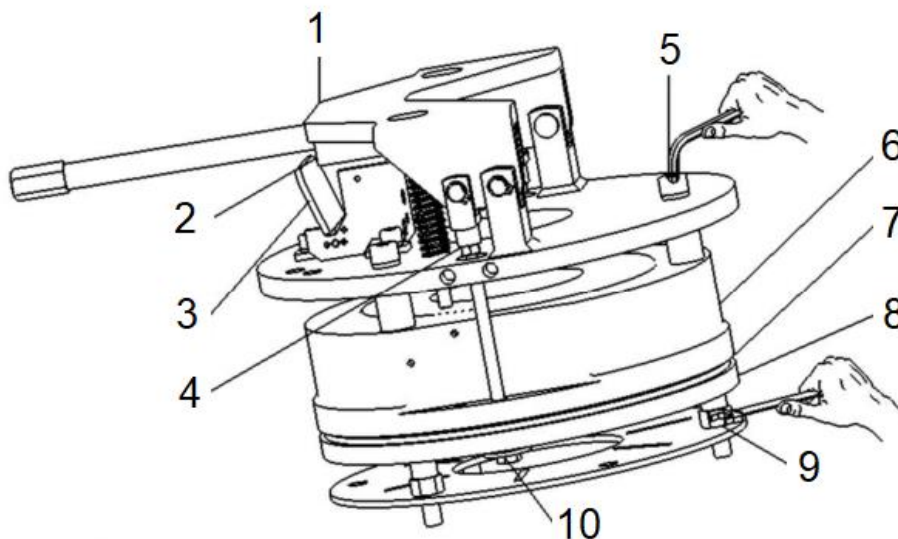


Fig. 6-32 Adjust electromagnetic brake gap

- | | |
|--------------------------------|------------------|
| (1) Release brake bottom plate | (2) Gap 2 |
| (3) Contact plate | (4) Nut |
| (5) Screw 1 | (6) Static core |
| (7) Gap 1 | (8) Moving plate |
| (9) Adjusting bolt | (10) Screw 2 |

■ Adjust the gap between the static core and the moving plate

- Put the tower crane in a safe state to ensure that the motor is operated on the premise that no safety accident occurs during disassembly. Otherwise, the following operations are prohibited;
- Disconnect all power supplies;
- Insert the 0.7mm feeler gauge (4) into gap 1, tighten the screw 1. When the feeler gauge is clamped, stop screwing the screw 1; As shown in Fig. behind.

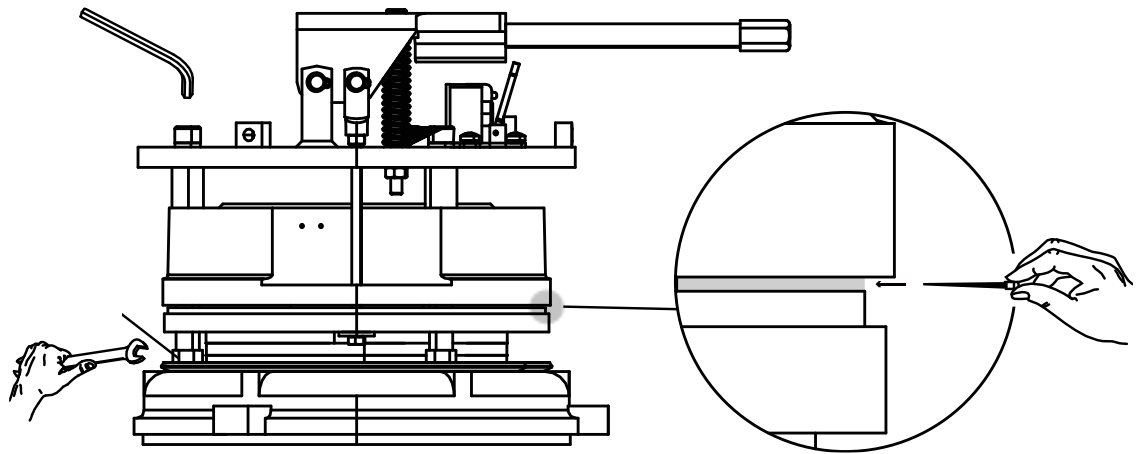


Fig. 6-33

- Turn the adjusting bolt to the left, stop turning the adjusting bolt when the feeler gauge can be easily taken out, and then tighten the screw 1 completely;
 - When the feeler gauge is pulled out, there is a sense of blockage and the gap meets the requirements. If the gap is too large, loosen the screw and adjust the bolt. Fine-tune to the right, and then fully tighten the screw 1. On the contrary, if the gap is too small, fine-tune the adjusting bolt to the right;
 - Repeat the above steps to adjust the front of the remaining 2 screws.
- Adjust the gap between the brake release bottom plate and the contact plate

After power on, the contact plate is attracted and the contact plate is in a vertical state. The gap (1) between the upper surface of the contact plate and the lower surface of the loose gate is 0.3~0.5mm. When adjusting the gap, first screw down the nut on the screw 2. When the gap is too large, screw the screw 2 upwards, and when the gap is too small, screw the screw 2 downwards until the gap meets the requirements, and then tighten the nut. As shown in Fig. behind.

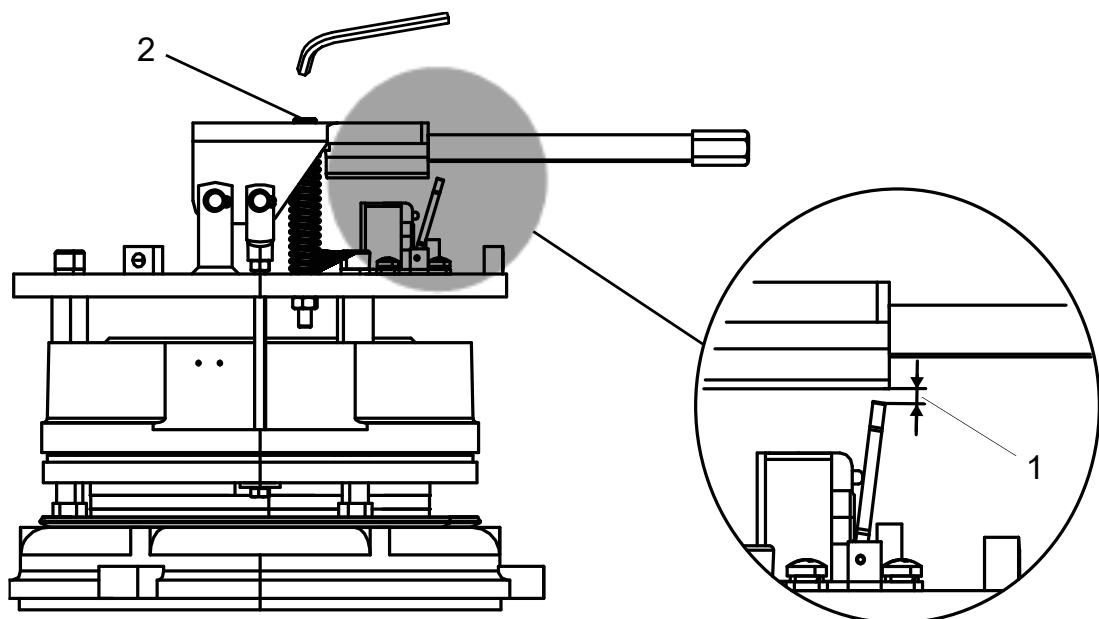


Fig. 6-34

- Replacement of the integral friction disc
- The overall friction disc should be replaced by a professionally trained person, otherwise it is easy to cause other damage;
- Put the tower crane in a safe state to ensure that the motor is disassembled without any safety accidents. One step operation, otherwise, the next operation is prohibited;
- Disconnect all power;
- Remove the weathervane and brake connecting wire;
- Remove the parts at the rear end of the integral friction disc one by one (the entire weathervane brake);
- Replace with a new integral friction disc of the same specification;
- Install the disassembled parts one by one, and adjust the brake according to the same clearance adjustment procedure of the electromagnetic brake.



After adjusting the brake and electric weathervane, check whether their braking, manual release and electric release functions are normal. After everything is normal, the motor can be put into use.

6.7.3 Maintenance for slewing ring

- The rolling groove of the slewing ring has been filled with 2# extreme pressure lithium base grease when leaves the factory. Add the grease once every 100 hours of operation, Addition of lithium base grease, should make the slewing mechanism rotated slowly, while rotation, while the oil, the grease filling evenly, until the seal a grease extrusion, said the old fat has been replaced by. Special working environment, such as rain, humidity, dust, temperature variation and continuous operation, it should shorten the lubrication cycle;
- After long time idle, enough new grease must be added to slewing ring;
- Exposure of tooth surface and tooth surface, often should clean the rubbish, and coated with grease corresponding;
- Slewing bearing the first 100 hours of operation, should check the retightening force of bolt. After examining every 500 hours of operation time, must keep enough preload force;
- The use of the process, if found, the impact of noise, power increases suddenly, should immediately stop check, troubleshooting, remove check when necessary;
- Never use water directly scour slewing bearing the use of the process, to water entering the race;
- To prevent the hard foreign body close to or into the meshing area;
- Always check the seal intact, if it is found that the sealing strip damaged should be replaced promptly, if found off should be timely reset.

6.8 Maintenance climbing mechanism

6.8.1 Working principle

The climbing hydraulic system consists of pump station, climbing cylinder and high-pressure hose. It can jack or lower the upper parts of the telescopic cage, and stop at any position for mounting or dismounting tower mast and tower sections. Refer to the figure below:

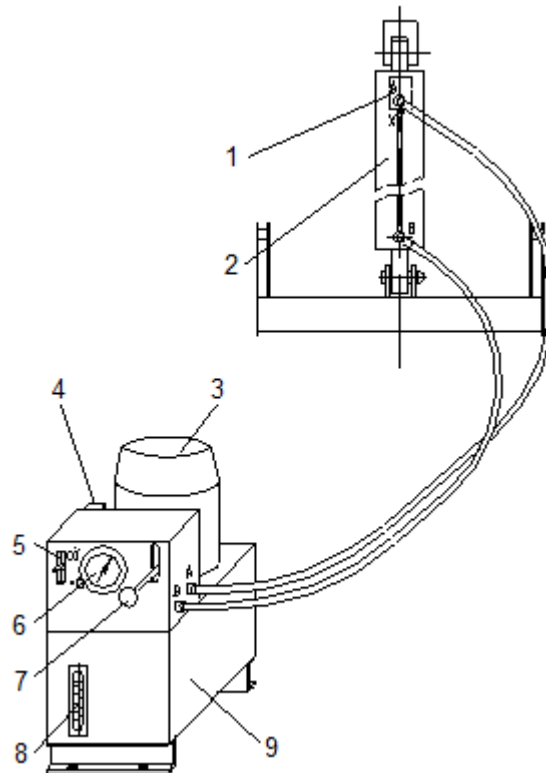


Fig. 6-35 Schematic diagram of tubes connecting of the Hydraulic system

- | | |
|--------------------|------------------------|
| (1) Balance valve | (2) Climbing cylinder |
| (3) Motor | (4) Terminal box |
| (5) Air switch | (6) Pressure gage |
| (7) Control handle | (8) Liquid level meter |
| (9) Pump station | |

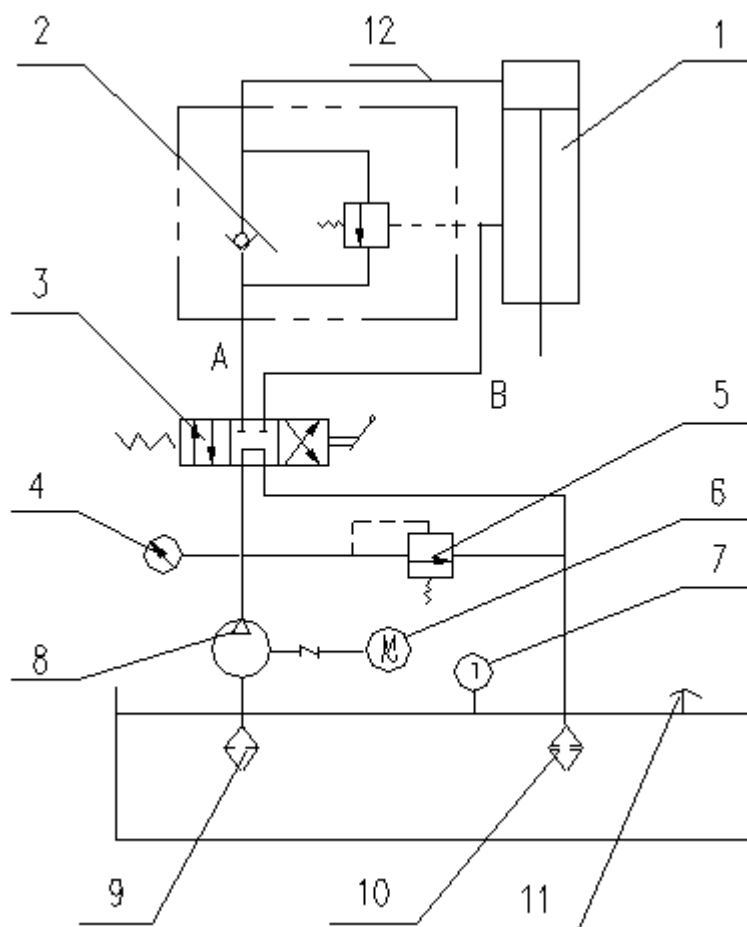


Fig. 6-36 Schematic diagram of hydraulic system

- | | |
|----------------------------------|----------------------|
| (1) Pump station | (2) Balance valve |
| (3) Manual control valve | (4) Pressure gauge |
| (5) High pressure overflow valve | (6) Motor |
| (7) Level meter | (8) Level meter |
| (9) Oil filter | (10) Fine oil filter |
| (11) Air filter | (12) Tube |

6.8.2 Erection, operation, and maintenance of the hydraulic pressure system

6.8.2.1 Erection, operation of the hydraulic pressure system

■ Oil cleaning

Screw open oil suction screen 11, fill 10μ hydraulic oil filtered by hand-held oil filter into the oil tank up to the upper limit mark. After that, start the oil pump motor (look down at the motor blades to see if the rotation direction is the same as that marked at the motor tail)



Pay attention to the fact that the pump may be rotated either left or right. Wrong wiring will cause no system working and pump burn-down.

■ Connect high-pressure hose openings for clean status

Connect ports A.B of the hydraulic pump station to the hydraulic cylinders through high-pressure hose. Screw down the connectors.

■ Air exhausting of the system

Unscrew the handle of overflow valve, and then the high-pressure hose-to-port A connector. Move the handle of hand-operated valve 3 to its up position. Start the motor to drive the air out of Port A until the pump noise has become normal and no foam formation from oil liquid. Make the cylinder into no-load status. Push the operating handle to let upper cylinder or piston rod move up and down at full strokes for several times to completely exhaust the air from cylinder into oil tank through oil hose.



When the piston rod has moved to its extreme position, pull back the handle immediately to its middle position and keep this position for several minutes until air bubbles in oil tank have disappeared, and then carry out another action.

■ System operation

Before system operation, check if the oil cylinder is well connected to the crane frame, including the check of relevant portions of the tower crane for meeting relevant technical requirements:

- 1) Maximum working pressure setting: Unscrew the locking nuts, in front of the control handle, of overflow valve 5 at non-climbing operation status. Start motor 6. Move the operating handle to upper position and extend the cylinder piston rod to its extreme position. At this time, pressure gauge 4 readings rise. Keep on screwing down the handle of the overflow valve until the readings on pressure gauge 4 have become stable at 31.5 Mpa. Screw down the locking nut in front of the regulating handle of the high-pressure overflow valve (The overflow valve shall not be adjusted by unauthorized or untrained person). Operate the handle in a reverse direction to retract the piston rod. Finally move the handle back to its middle position.
- 2) Start motor, and move operating handle to its up position. Extrude the cylinder piston rod to hang the hanging plate connected to the piston rod into the lugs slot of the tower mast section. Carry out the climbing operation for new section adding (or tower section dismantling).

6.8.2.2 Maintenance and precautions for hydraulic system

The hydraulic system is super high-pressure or high-pressure equipment. The whole process from oil filling to adjustment shall be accomplished strictly according to the stipulations in its operating instructions.

- Hydraulic oil for the system
 - Anti-wear hydraulic oil L-HM 46 shall be used in the hydraulic system according to the regulations. Mixture other hydraulic oils or fill directly without filtering the oil are prohibited. When oil foaming or emulsification, should be timely cleaning mailbox replacement of new oil;
 - Filling oil: Fully fill the tank with oil for the first time. After start-up, extrude the cylinder rod, and then retract the cylinder rod. At this time, fill the tank with make-up oil up to the tank upper limit mark;
 - At this time, it is a high-pressure hydraulic system with strict requirements of highly cleaned oil, which should be filtered for 4~6 hours by hand-hold filter. The oil cleanness should reach 7~8 levels (NAS1638) before starting the system;
 - The oil should be completely changed after the system working for 2400h and add part of clean oil after working for 1 month;
- Shut the system when it is out of service because of the poor condition of ventilation;
- To avoid damage the components, the pump station should be protected well by rainproof shield when raining;
- Be careful when lifting and transporting. No charge and discharge rudely. Don't put it in environment that can corrode metal and rubber.

6.8.2.3 Common troubles and troubleshooting

Table 6-16 The common troubles and methods of troubleshooting

No.	Trouble	Reason	Troubleshooting
1	Pump station outputs no pressure / Pressure can't be adjusted to rated value / Pressure is not stable	Motor rotates in wrong direction	Commutate the motor line
		Oil relief valve get stuck by impurity in unclean oil	Dismantle main valve and clean it
		Hose had ruptured and spill oil	Dismantle the hose, weld the crack or replace it
		Hose joint is loose	Tighten the joint
		Seal of joint is broken	Replace the broken seal
		Coarse oil filter is blocked	Clean it
		Pump is broken for overloading	Replace the pump
2	Motor don't revolve after power source is connected	Joint at line terminal and circuit breaker has loosened	Check the line, connect it according to the schematic circuit diagram
		Circuit breaker automatically tripped or burned because of overloading or short circuit	Check the contact and breaker, repair or replace it



- *Never let the cylinder's balance valve and the pipeline be crashed, check that if the clamping screw of the balance valve is loose when change place and set up the tower, to avoid the danger!*
- *The O-ring between the balance valve and cylinder should be change once two year!*
- *Don't adjust the pressure of the pump station when the cylinder on the work, only in the condition that the piston rod of the cylinder retract or extend!*
- *When the piston rod retracts completely, the pressure lever of the oil tank should reach the max lever position!*
- *To avoid safety accident, the climbing pumping station should not be used when natural wind over fourth lever!*
- *When power off and the pump out of work, adjust the balance valve clockwise to make the piston rod retract.*
- *If the pump station out of work for a long time, it must run for more than 30-minutes before use.*

6.9 Maintenance of travelling chassis parts

6.9.1 Maintenance of driving/driven dollies

- Check each connection parts every day, the connection should be tightened and reliable.
- Check reliability of rail clamps and pin shaft, and settle it if abnormality occurs.
- Check each traveling limit switch every day, they should be sensitive and reliable.
- Add lubricating oil into each lubricating point every two months. The lubricating of each bogie is shown as

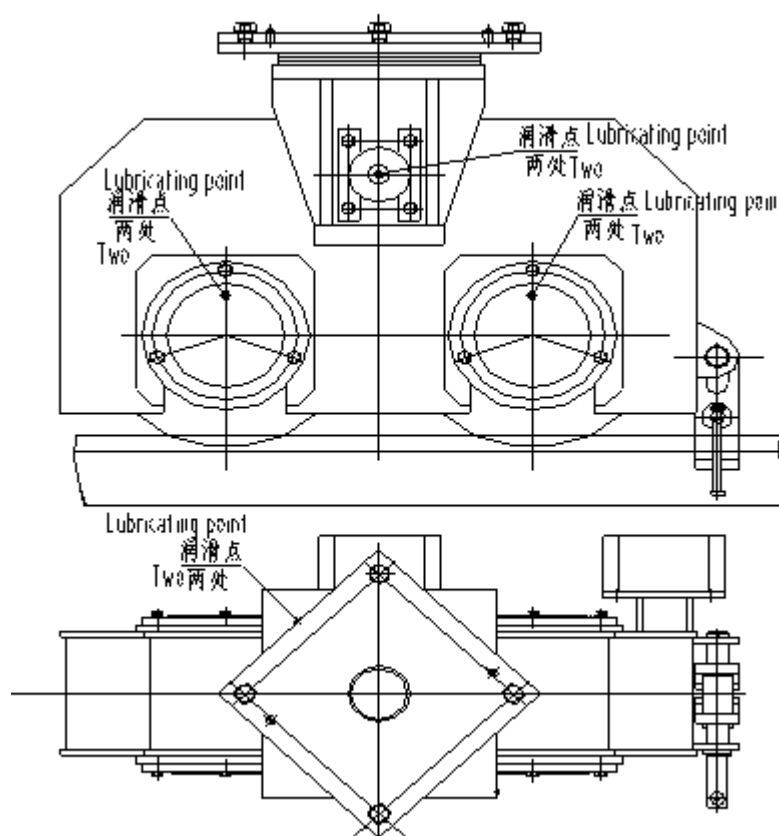
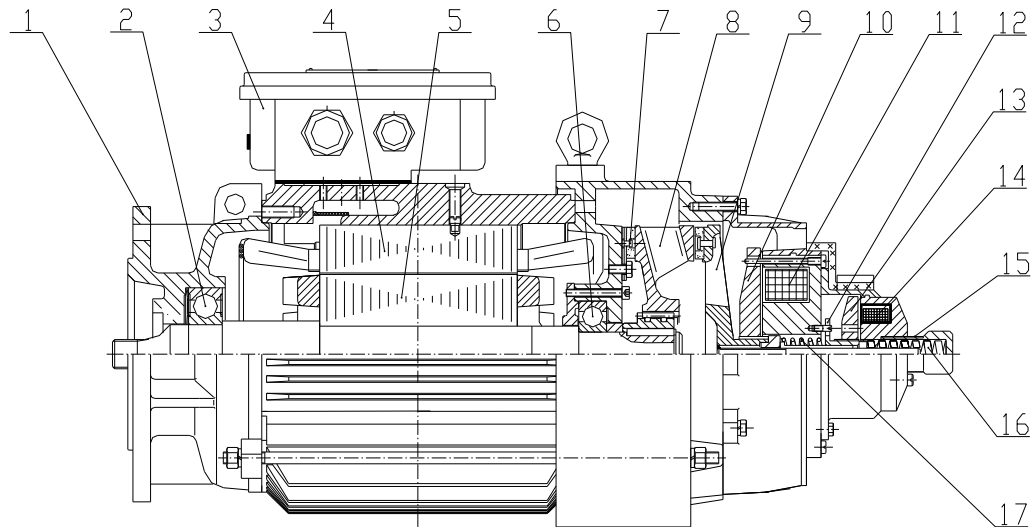


Fig. 6-37 Lubricating points of the bogie

- Check the wheels every 6 working months. It should be scrapped if the following conditions occur:
 - Cracks;
 - The worn value of wheel surface thickness arrives 15% of original thickness;
 - The worn value of wheel rim thickness arrives 50% of original thickness.

6.9.2 Maintenance of traveling motor



1. Front end cover; 2. Bearing; 3. Terminal box; 4. Stator; 5. Rotator; 6. Bearing; 7. Friction plate; 8. Brake disc (1); 9. Brake disc (2); 10. Armature (1); 11. Iron core with shell (1); 12. Spring block; 13. Armature (2); 14. Iron core with shell (2); 15. Spring Chamber; 16. Spring (1) 17. Spring (2)

Fig. 6-38 Parts of the traveling motor

■ **Motor structure diagram is shown as Fig. 6-38, maintain the motor periodically as following items:**

1. Check each terminal block to see if the contact is well;
2. Check insulating resistance of stator and the rotor winding with a ohmmeter, the value of the resistances should not be below 0.5MΩ;
3. Environment should be kept clean during operation to prevent all kinds of dirt being absorbed;
4. Motor bearing is special sealed bearing, during it using period, should not change lubricating grease. When the life of bearing over, the oscillation and noise of motor will augment obviously, check the radial clearance of bearing, if reaches 0.1mm, should instead of it in time;
5. When motor is started, excitation coil is electrified at one time, brake open; when motor is stop, the control of frequency conversion could let motor from speed of working state to zero or adjacent zero gradually, excitation coil is cut off, it is braking state. So, the brake and release of electromagnetism brake must be sensitive and reliable;
6. Check every part of brake periodically, clear begrime and ordure of braking disc, friction piece, clean the outlet/inlet wind passage;
7. Check the braking moment of brake, value of clearance and friction piece periodically. When static braking moment less than stated value 40Nm or clearance more than 1.2mm, static braking moment and value of clearance should be adjusted in time, if friction piece wear and near to metal surface, friction piece should be changed in time.

■ The adjustment of static brake moment and clearance is:

1. Cut off all power; turn the down lag and locknut; take shield;
2. Screw off the orientation bolt; unscrew nut (5mm about);
3. Screw on spring chamber, compress the braking spring, let the static braking moment to the regulate value 40Nm, screw the nut closely;
4. Using tool entering the wind window of excitation iron core poke the teeth circle of armature, until armature keep close to excitation iron core, drill through orientation bolt, withstand armature, poking the armature on the right slowly, find the location of the first hole of orientation bolt drilling armature. At this moment, air clearance is 0.8 mm (armature and orientation bolt of excitation iron core locate on the circle with the same radius, 12 holes distribute equably, the screw pitch of whorl connected with armature and braking disc;
5. Fit on the shield; install and screw locknut closely; install lag and screw closely.

■ Replace method of friction piece:

1. Cut off all power; unscrew lag and locknut on the left; take off shield;
2. Unscrew off orientation bolt; unscrew off locknut and release nut;
3. Unscrew the spring chamber and take-out braking spring and spring retaining pad;
4. Unscrew the bolt connecting the excitation coil iron core and shell, remove the excitation iron core carefully (be careful of the lead of protection coil), remove the friction disc and braking disc. (Notice: "3)" , "4)" step should not be upside down, or else attain the protruding desk on the hole of the bolt;
5. Take off the friction disc of shell and exchange the same standard new friction disc; remove the friction piece on the friction disc, exchange the same standard new friction piece, and felt hard;
6. Install braking disc, friction disc, shell body, excitation coil, spring retaining pad, braking spring and spring chamber according contrary "3)", "4)" step;
7. Adjust the static braking moment and air clearance according to the adjustment method of static braking moment and air clearance; install shield, screw the locknut;
8. Screw tow release nut, lock each other off spring chamber 5mm.

After every adjustment of electromagnetism, should check handful releasing equipment and whether snort the armature after electrified, if it is eligible, the motor can be used.

6.9.3 Maintenance of the cable drum

Notice:

- a) Cut off the power before open the collector ring;
 - b) Prohibit inserting stop parts into nut indentation during operation;
 - c) Lubricating oil level in reducer should be above the center position of the sight hole;
 - d) When the crane moves toward the direction of power, the motor of cable drum should be started simultaneously with traveling mechanism, while the traveling mechanism stops, the motor of the cable drum should power off after 3 seconds.
1. Must exchange lubricating oil in reducer after the first one-month operation;
 2. Check the oil level of reducer every two months, when it is below center of sight hole, and then add HL-30 lubricating oil;
 3. Check the tightness of electric parts of collector ring every two months, to ensure good contact and reliable connection of cable fittings. At same time, measure insulation condition, the insulating resistance should not be below 5 M Ω ;
 4. Change lubricating oil in the reducer every year. Turn out the hexagon plug screw at bottom to drain off dirt oil, and screw out brake parts simultaneously. Screw on the hexagon plug screw and add clean HL-30 lubricating oil, Screw on brake parts after cleaning the dirt oil.
 5. Keep the surface of collector ring, motor, reducer cleaning;
 6. Exchange parts in time if the parts are worn greatly and affect performance.

6.9.4 Bearing model

Wheel bearing model: GB/T288-1994 Bearing 22220C 4 wheels for each bogie.

6.10 Rope

6.10.1 Basic Knowledge of Rope

1) The structure of rope

Wire rope is a spiral structure, which made up of a certain number of a layer or layers of wire strands, see the figure below.

2) The lay of rope as the following figure

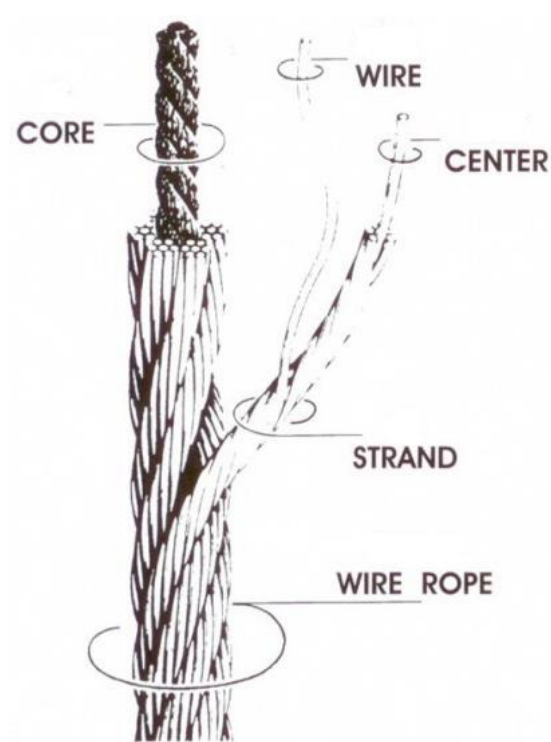


Fig. 6-39 The structure of Rope

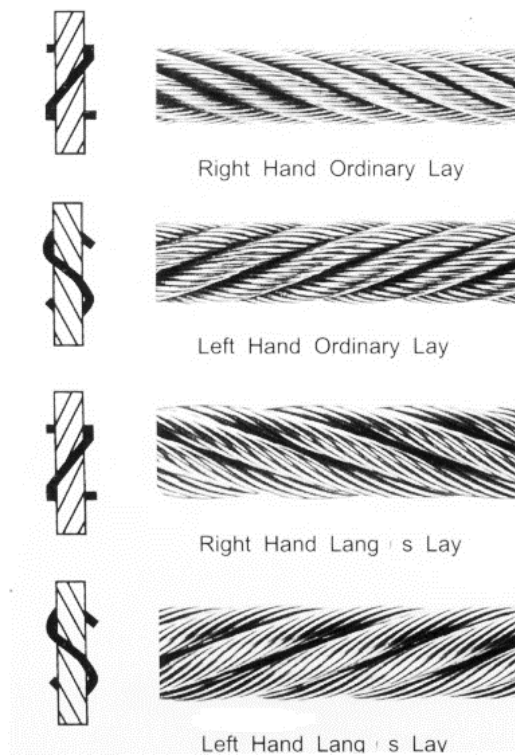


Fig. 6-40 The twist of Rope

3) Measuring the Diameter of Rope

Measure the diameter of the rope through correct method, see the figure below.

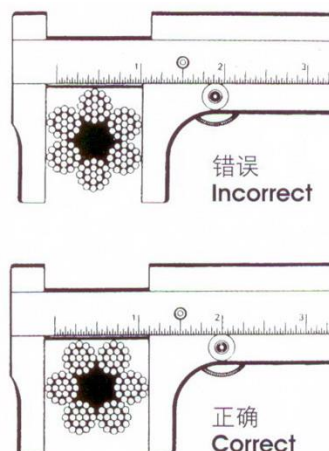


Fig. 6-41 Measuring the diameter of the rope

4) Discharge and Storage

To avoid the contingency, be careful when discharging the ropes. The wind should not go down. It is not allowable to insert the rope by metal hook or lifter fork, see the figure below.

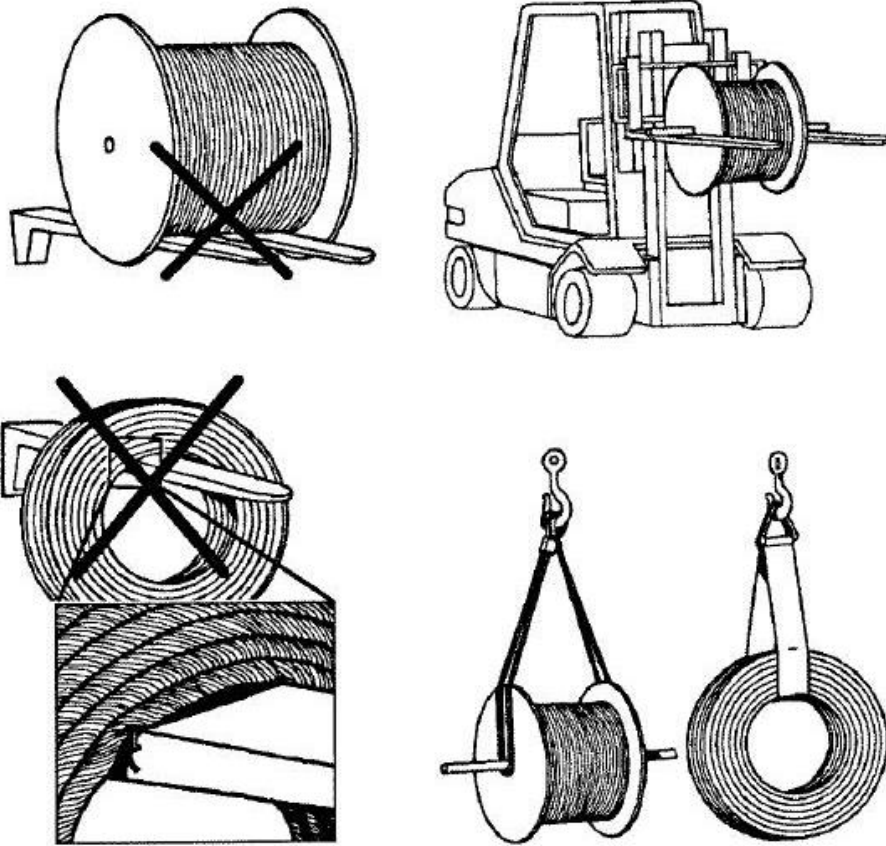


Fig. 6-42 Discharging the ropes

Ropes should be stored in the cool and dry warehouse and cannot be in contact with the ground. Ropes must not be stored in the location which is easy to be affected by chemistry fog, steam, or other corrosives. Check the stored ropes regularly, and if necessary, bind the ropes up. If outdoors storage cannot be avoided, cover the ropes to avoid the damp corroding the ropes, see the figure below.

Thoroughly clean the discharged from the crane. Bind every rope up before storing them. The ropes whose lengths exceed 30m should be stored on the wind.

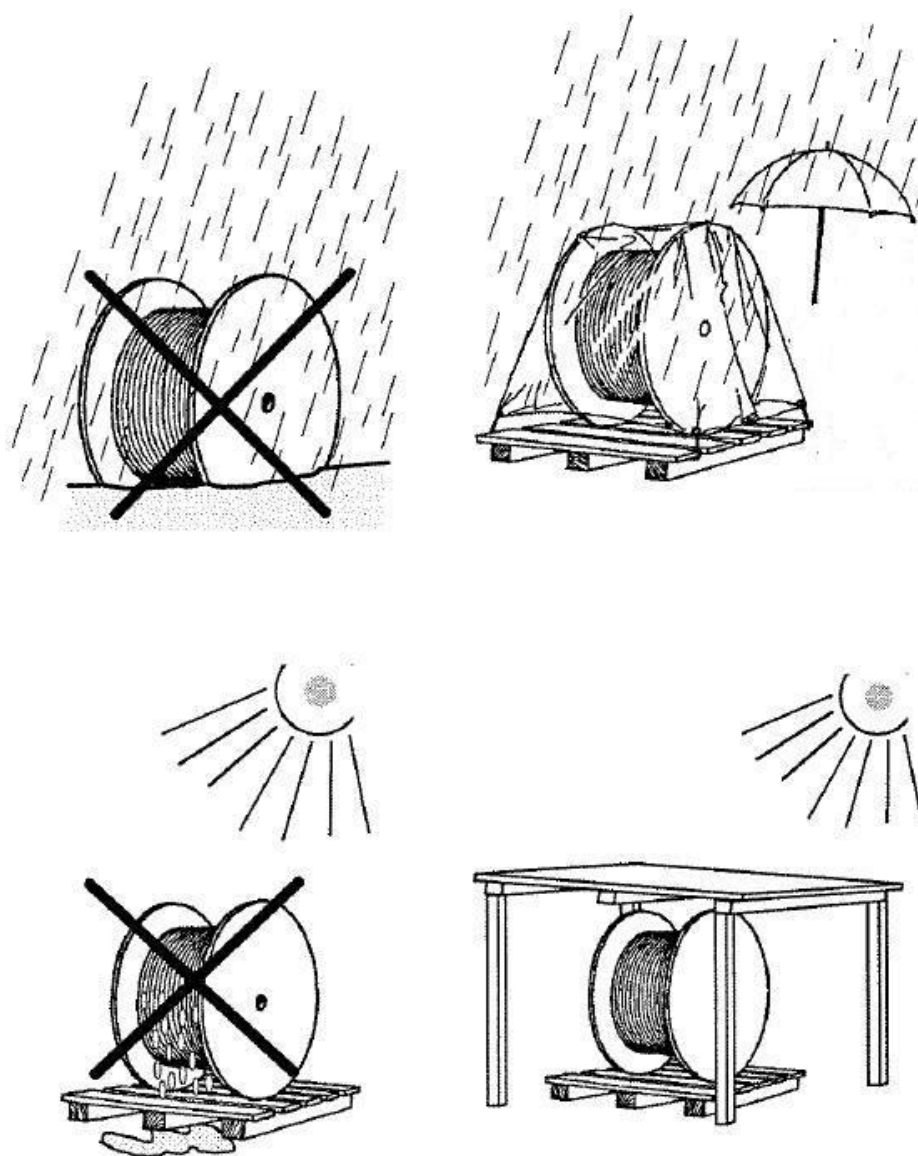


Fig. 6-43 The storage of the rope

5) Uniting the Rope

When uniting the rope, put the rope on specified bracket or reeve a steel pipe through rope wind hole, hoist the two ends after being put rope sleeves and rotate the rope wind slowly, refer to the figure below.

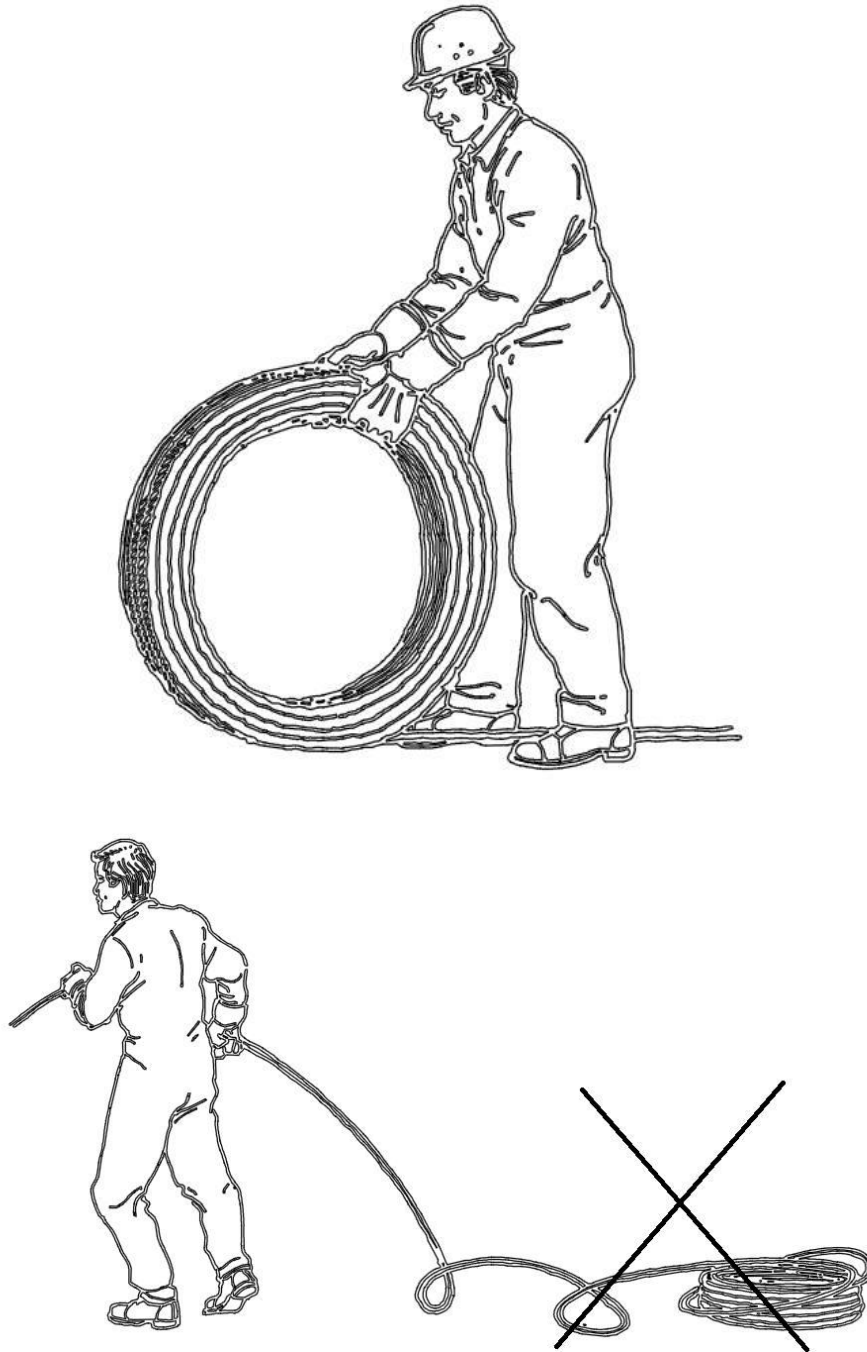
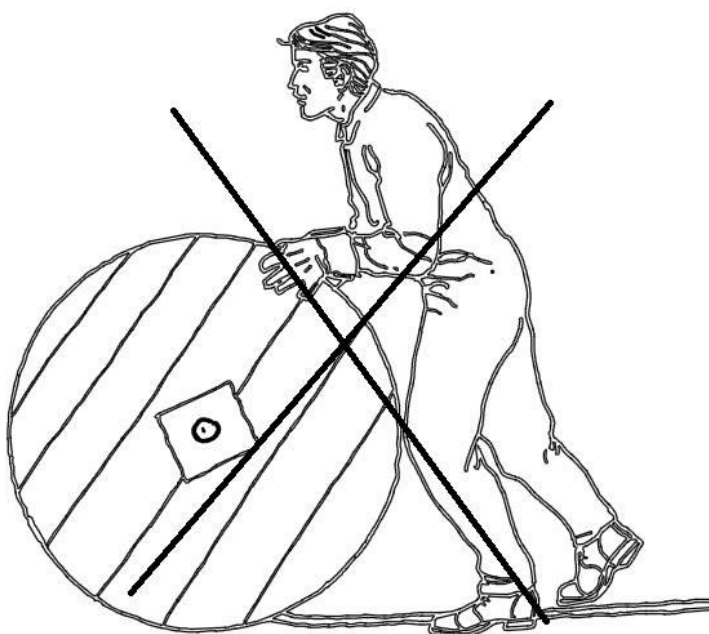


Fig. 6-44 Untiring rope from rope sheaf



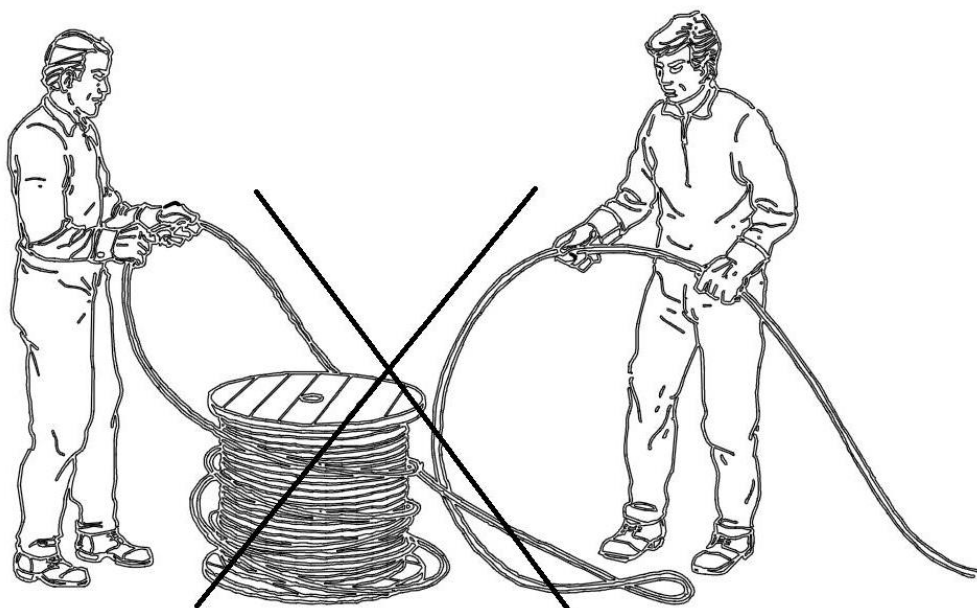


Fig. 6-45 Uniting rope from rope wind

6) Rope clamp

■ Arrangement of the rope clamps

The rope clamp must be buckled on the working rope line in such a way as is shown as the following figure. Buckle the U-shape rope clamp on the end of the rope.

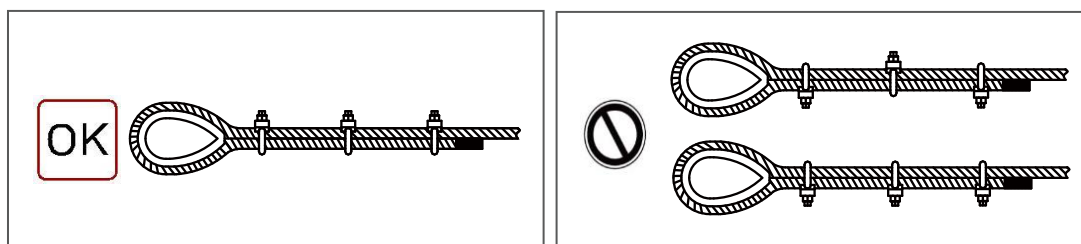


Fig. 6-46 Correct method to arrange the rope clamps

■ Number of rope clamps

For the situation according with the requirement of this standard, the minimum number of rope clamps needed by every connecting section is as indicated in the next table.

Table 6-17 The minimum number of rope clamps needed

Nominal dimension of rope clamp mm (nominal diameter of rope d)	≤19	>19~32	>32~38	>38~44	>44~60
The minimum number of the rope clamp (suit)	3	4	5	6	7

■ Interval between two rope clamps

As the figure below, the distance A between two rope clamps is about 6~7 times of the rope diameter.

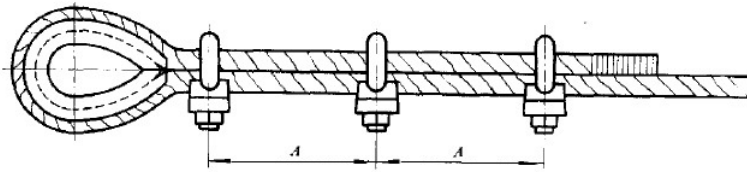


Fig. 6-47 Interval between two rope clamps

■ The fastening method of rope clamps

Considering every rope clamp can be forced reasonably when you fasten and fix the clamps, the farthest clamp should not be fastened and fixed firstly. The rope clamp abutting the rope ring (the first rope clamp) should be as close to the rope ring as possible, and the rope clamp shall be correctly tightened without damaging the outside layer of wires.

6.10.2 Rope List

Ropes for **T1200-64Q** are shown as the table below:

Table 6-18 Ropes for **T1200-64Q**

Designation	Specification	Diameter (mm)	Nominal length mass kg/m	Minimum braking force (kN)	Fixing method	Remark
Hoisting rope	GS-K34- Φ30-1960	Φ30	4.59	760	Pressing plate	The diameters of the selected ropes must meet the requirement listed in the table
Trolley rope	6×29Fi+IWR- 16-1960-ZS	Φ16	1.18	179	Pressing plate	The minimum breaking force of the rope shall not be less than the value listed in the table

6.10.3 The length of the rope

The length of the selected rope must meet the use requirement of this tower crane. There must be three rounds of rope on the terminal location of the drum at least. According to the use condition, if it is needed to cut a section of rope from the long rope, the two ends need special handling or adopt proper method to avoid the rope loose during cutting off the rope, see the figure below.

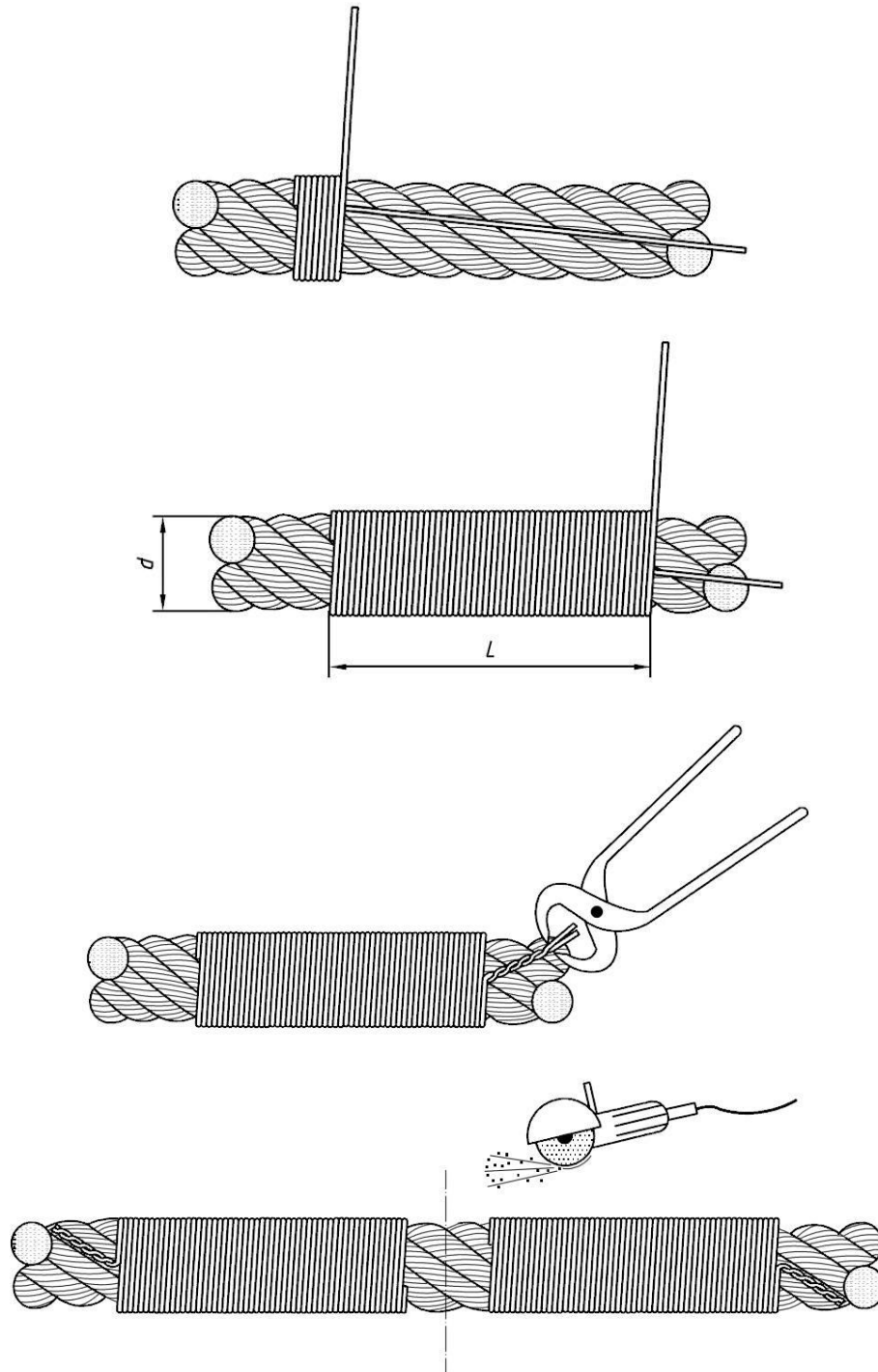


Fig. 6-48 Preparation for cutting off the rope ($L \geq 2d$)

6.10.3.1 Calculating the Length of the Hoisting rope

Total length required for hoisting rope

$$L = L_0 + f \times H$$

L_0 ——The sum of the rope lengths of the hook on the max hoisting height, m; see the table below.

f ——Falls used;

H ——Hoisting height, m.

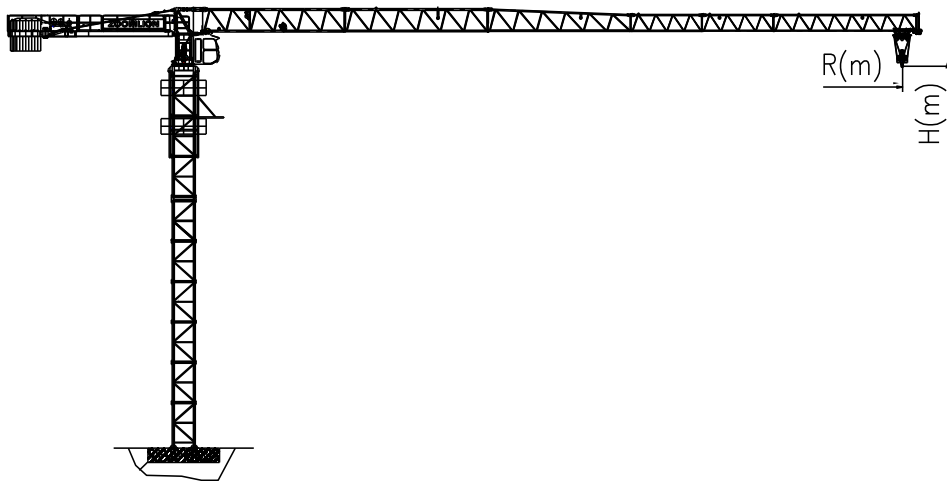


Fig. 6-49 Calculating the Length of the Hoisting rope

Table 6-19 The length of hoisting rope for different length jibs

Jib(m)	25	30	35	40	45	50	55	60	65	70	75	80
L_0 (m)	105	110	115	120	125	130	135	140	145	150	155	160

6.10.3.2 The Length of the Trolley Rope

The length of trolley rope is fixed as the jib changing, see the table below:

Table 6-20 The length of trolley rope for different length jibs

Jib lengths (m)	25	30	35	40	45	50	55	60	65	70	75	80
Rope I Lengths (m)	42	52	62	72	82	92	102	112	122	132	142	152
Rope II Lengths (m)	51	56	61	66	71	76	81	86	91	96	101	106

6.10.4 Installation of the Rope

The rope should not be disturbed during installation, when uncoiling the wire rope from a wind or coil, every precaution shall be taken to avoid the Tweaked or tightened kink, bends etc. of the rope.

During installation, the rope shall always bend in the same direction: i.e., pay out from the top of the wind to the top of the drum, or from the bottom of the wind to the bottom of the drum, see the figure below.

Care shall be taken to ensure that termination anchorages are made and secured in accordance with the instructions in the crane manual.

If the rope rubs against any part of the crane during installation, then the points of contact shall be suitably protected.

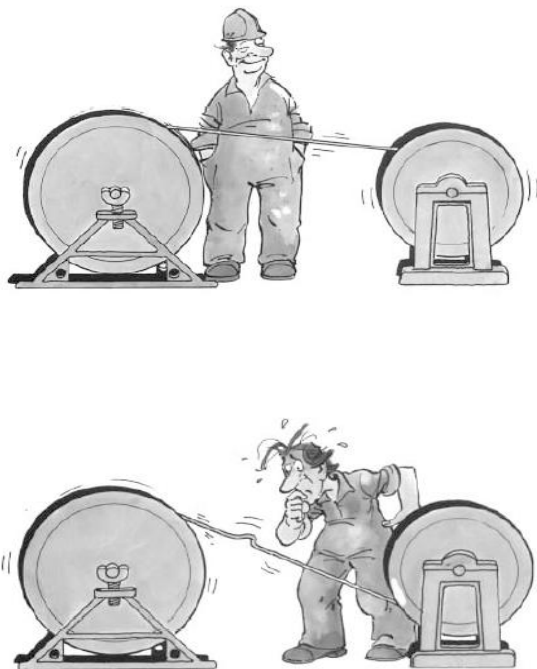


Fig. 6-50 The rope winding

Replacing steel rope of Tower crane should be carried out in accordance with the relevant chapters in the tower crane operation manual to correctly wear around, and make wire rope bend in the same direction as far as possible, otherwise will seriously affect the life of wire rope.

Wire rope should be installed at pre-tightening condition.

Before put into use wire rope on hoisting machinery, the user should ensure that all related to the wire rope work device is installed in place and working properly.

In order to make the steel wire rope stable in place, about 10% of the rated load shall be used to rope wheel system running operation for several times, in order to make wire rope can be accurate and stable in the system, more joint drum steel wire rope, the rope internal release, it is advantageous to the rope neatly, and effectively prevent the wire rope to disturb.

6.10.4.1 Fixing rope head

One end of rope connected drum; another end connected jib end anti-twist device.

■ Fixed the rope and drum

The rope is connected to drum through a wedge sleeve. (See Fig 6-29a).

- 1) The feeding direction should be consistent with the vertical edge of the wedge sleeve and the drum feeding direction;
- 2) Wedge the wedge with a mallet or a copper rod;
- 3) The length of the outstretched wedge sleeve of the rope head is $65\sim78\text{mm}$, and the length of the tighten rope head is $20\sim26\text{mm}$ or conical fuse.

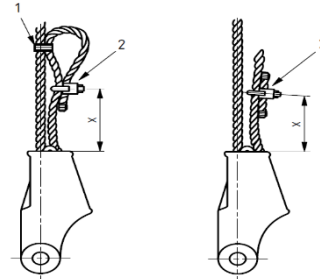
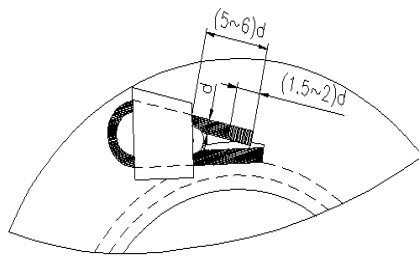


Fig. 6-51a The end of drum wedge connection Fig. 6-51b The end of jib end wedge connection

Fig. 6-51 Connected wedge

■ Fixed the rope and the jib end

The rope is connected to jib end anti-twist device through a wedge sleeve (see Fig. 6-51b)

- 1) The extension direction of the force rope should be threaded through the pinhole.
- 2) The rope clamp specification should match the diameter of the rope.
- 3) Rope clamp position is: $X=70\sim85\text{mm}$.
- 4) Wedge the wedge with a mallet or a copper rod.

■ Anti-twist device

Adjust the anti-twist device to the state of the release (Can be free rotation) or lock (cannot free rotation) according to the performance of the rope.

- 1) For the resistance rotary rope with its rotation performance less than 360° (e.g 35(W)×7), the anti-twist device generally be in release state.
- 2) For the non-resistance rotary rope(e.g 6×29), the anti-twist device generally be in a lock state.

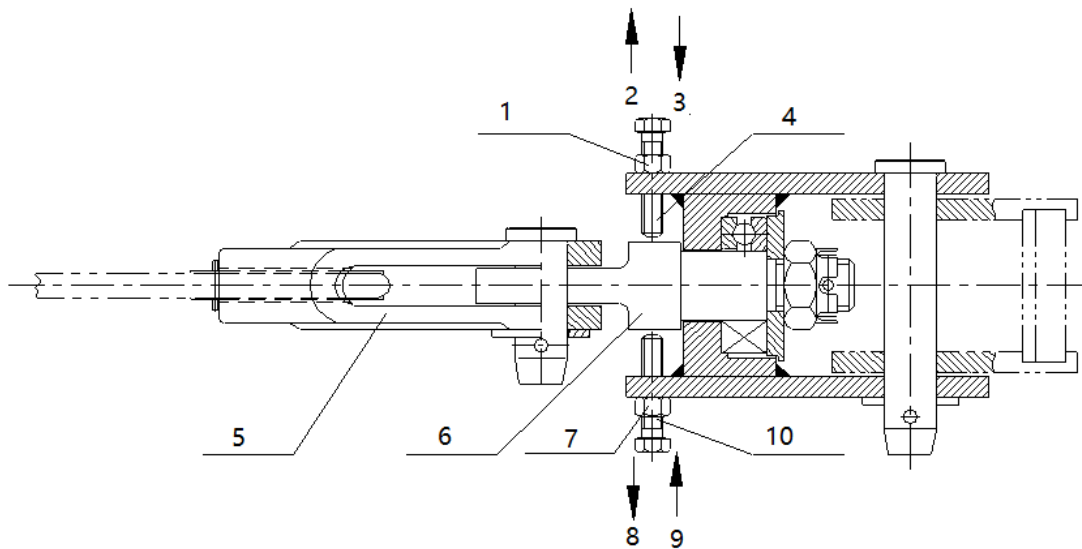


Fig. 6-52 Anti-twist device

- | | |
|------------------|-----------------------|
| (1) Nut | (2) Release |
| (3) Lock | (4) Bolt |
| (5) Wedge sleeve | (6) Anti-twist device |
| (7) Nut | (8) Release |
| (9) Lock | (10) Bolt |

6.10.5 Discard Criteria of Rope

1) Nature and number of broken wires

The table below take these factors into account when considered in conjunction with the factors given in (2) to (19). So, it can be applied to all structure's ropes.

Table 6-21 The number of visible broken wires that meet or exceed the scrap standard in single strand wire rope and parallel twist compacted wire rope used on steel pulley

Kinds of wires RCN	Number of loads bearing wires of the outer layer of the rope n	The number of visible broken wire rope Concerned with fatigue when lifting machinery must be scrapped					
		A section of wire rope working on a steel pulley and mill or single layer wound on a wind (Random distribution of wire breaks)				Section of multi-layer wire rope wound on the drum	
		Working classification M1~M4 or unknown classification				Off Working classification	
		Interaction of twist		Concurrent twist		Interaction of twist	
		Length arranges				Length arrange	
		>6d ^e	>30d ^e	>6d ^e	>30d ^e	>6d ^e	>30d ^e
01	n≤50	2	4	1	2	4	8
02	51≤n≤75	3	6	2	3	6	12
03	76≤n≤100	4	8	2	4	8	16
04	101≤n≤120	5	10	2	5	10	20
05	121≤n≤140	6	11	3	6	12	22
06	141≤n≤160	6	13	3	6	12	26
07	161≤n≤180	7	14	4	7	14	28
08	181≤n≤200	8	16	4	8	16	32
09	201≤n≤220	9	18	4	9	18	36
10	221≤n≤240	10	19	5	10	20	38
11	241≤n≤260	10	21	5	10	20	42
12	261≤n≤280	11	22	6	11	22	44
13	281≤n≤300	12	24	6	12	24	48
	n>300	0.04n	0.08n	0.02n	0.04n	0.08n	0.16n
Note 1: Silu type wires ropes with outer strands and 519 wires per share (e.g 6×1 silu type) are listed in two rows in the table. The top row represents the number of normally placed outer strands carrying wires.							
Note 2: The above values in the multilayer wound wind section may also be applied to other sections of the wire rope working on pulleys made of synthetic materials or having synthetic wheel lining. However, it is not applicable to wire ropes which are specially made of synthetic materials or which are operated on a single winding pulley consisting of a composite wheel lining.							
a. Filled steel wire in standard is not regarded as load-bearing steel wire, so it is not included in the n value.							

b. A broken wire will have two broken ends (count by one wire)
c. These values apply to sections that are damaged by interference between the jump zone and the overlap layer due to the effect of the entanglement angle (and not only those section where the pulley is working and where the wire rope is not wound around the drum).
d. Two times of the number of broken wires listed above can be used for mechanisms whose working class is known to be M5~M8. See ISO 4308-1.
e. Nominal diameter of the wire rope.

Table 6-22 Number of visible broken wires of non-rotating wire rope that meet or exceed the scrap standard

Kinds of wires RCN	Number of loads bearing wires of the outer layer of the rope n	The number of visible broken wire rope Concerned with fatigue when lifting machinery must be scrapped			
		A section of wire rope working on a steel pulley and mill or single layer wound on a wind (Random distribution of wire breaks)		Section of multi-layer wire rope wound on the drum	
		Length arranges		Length arranges	
		>6de	>30de	>6de	>30de
21	4 n ≤100	2	4	2	4
	3n or 4 n ≤100	2	4	4	8
	at least 11 outer layers				
23-1	76≤n≤100	2	4	4	8
23-2	101≤n≤120	2	4	5	10
23-3	121≤n≤140	2	4	6	11
24	141≤n≤160	3	6	6	13
25	161≤n≤180	4	7	7	14
26	181≤n≤200	4	8	8	16
27	201≤n≤220	4	9	9	18
28	221≤n≤240	5	10	10	19
29	241≤n≤260	5	10	10	21
30	261≤n≤280	6	11	11	22
31	281≤n≤300	6	12	12	24
	n>300	6	12	12	24



Only use ropes which correspond with the specifications in the ZOOMLION rope list.

2) Broken wires at the termination

Broken wires at, or adjacent to, the termination, even if few, are indicative of high stresses at this position and can be caused by incorrect fitting of the termination. The cause of this deterioration shall be investigated and, where possible, the termination shall be remade, shortening the rope if sufficient length remains for further use, otherwise the rope shall be discarded.

3) Localized grouping of broken wires

Where broken wires are very close together, constituting a localized grouping of such breaks, the rope shall be discarded. If the grouping of such breaks occurs in a length less than $6d$ or is concentrated in any one strand, it may be necessary to discard the rope even if the number of wire breaks is smaller than the maximum number shown in the table above.

4) Increase rate of the broken wires

In applications where the predominant cause of rope deterioration is fatigue, broken wires will appear after a certain period of usage, and the number of breaks will progressively increase over time. When the time interval becomes shorter and shorter, it is recommended to conduct careful periodic examination and recording of the number of broken wires, with a view to establishing the rate of increase in the number of broken wires. This law may be used to confirm a future date for discarding rope.

5) Fracture of strands

If a complete strand fracture occurs, the rope shall be immediately discarded.

6) Reduction of rope diameter resulting from core deterioration

Reduction of rope diameter results from deterioration of a fiber core or fracture of a steel core. If rope diameters notable reduces, the rope shall be immediately discarded.

Low values of deterioration might not be so apparent from normal examination, particularly if the rope stresses are well balanced throughout the individual strands. However, the condition can result in a high loss of rope strength, so any suggestion of such internal deterioration shall be verified by internal examination procedures. If such deterioration is confirmed, the rope shall be discarded.

7) External abrasion

Abrasion of the crown wires of outer strands in the rope results from rubbing contact, under pressure, with the grooves in the sheaves and drums. The condition is particularly evident on moving ropes at points of sheave contact when the load is being accelerated or decelerated, and is revealed by flat surfaces on the outer wires.

Wear is promoted by lack of lubrication, or incorrect lubrication, and by the presence of dust and grit. Wear reduces the strength of ropes by reducing the cross-sectional area of the steel strands. If, due to external wear, the actual rope diameter has decreased by 7% or more of the nominal rope diameter, the rope shall be discarded even if no wire breaks are visible.

8) Elasticity decreases

Under certain circumstances usually associated with the working environment, a rope can sustain a distinct decrease in elasticity and is thus unsafe for further use. Decreased elasticity is difficult to detect. If the examiner has any doubt, advice shall be obtained from a specialist in wire ropes.

While no wire breaks may be visible, the wire rope will be noticeably stiffer to handle and will certainly have a reduction in diameter greater than that related purely to wear of individual wires. This condition can lead to abrupt failure under dynamic loading and is sufficient justification for immediate discard.

9) External and internal corrosion

- Corrosion of the outer wires can often be detected visually. When the pits appear on the wires and the wires are quite loose, the rope should be discarded.
- If there is any indication of internal corrosion, the rope should be carried out internal examination as indicated by governors. The ropes with serious internal corrosion are sufficient to be discarded immediately.

10) Waviness distortion

As the figure below, when the waviness distortion occurs, when the rope length is no more than $25d$, $d_1 > 4d/3$, the rope shall be discarded. In the formula d is the nominal diameter of the rope and d_1 is the diameter corresponding to the envelope of the distorted rope.

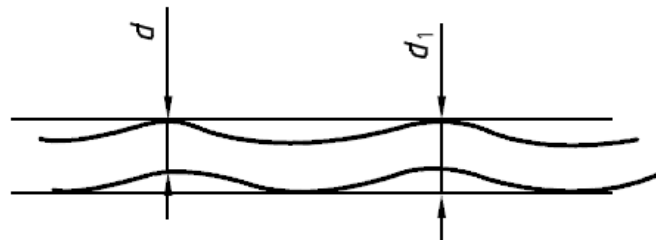


Fig. 6-53 Waviness distortion

11) Basket or lantern deformation

Basket or lantern deformation is a result of a difference in length between the rope core and the outer layer of strands. Ropes with a basket or lantern deformation shall be immediately discarded as the figure below.



Fig. 6-54 Basket or lantern deformation

12) Strand protrusion

Strand protrusion usually happens with basket or lantern deformation. It shows the rope misbalanced. Rope with strand protrusion shall be immediately discarded as the figure below.



Fig. 6-55 Strand protrusion

13) Wire protrusion

In wire protrusion, certain wires or groups of wires rise, on the side of the rope opposite to the sheave groove, in the form of loops. Rope with wire protrusion shall be immediately discarded as the figure below.



Fig. 6-56 Wire protrusion

14) Local increase of diameter of the rope

A local increase in rope diameter can occur and might affect a relatively long length of the rope. This condition usually relates to a deformation of the core (in particular environments, a fiber core can swell up owing to the effect of moisture) and consequently creates imbalance in the outer strands, which become incorrectly oriented. If the local actual rope diameter increases seriously, the rope shall be immediately discarded as the figure below.



Fig. 6-57 Local increase of diameter of the rope

15) Flattened portions

Flattened portions of rope results from machine accidents as the figure below. If flattened portions of rope is serious, the rope shall be discarded immediately.



Fig. 6-58 Flattened portions

16) Kinks or tightened loops

A kink or tightened loop is a deformation created by a loop in the rope which has been tightened without allowing for rotation about its axis. Imbalance of lay length occurs, which will cause excessive wear, and in severe cases the rope will be so distorted that it will have only a small proportion of its strength remaining. As the figure below showing, rope with serious kinks tightened loop shall be immediately discarded.



Fig. 6-59 Tweaked or tightened kink

17) Bends

Bends are angular deformations of the rope caused by external influence. Rope with a severe bend should be immediately discarded as the figure below.

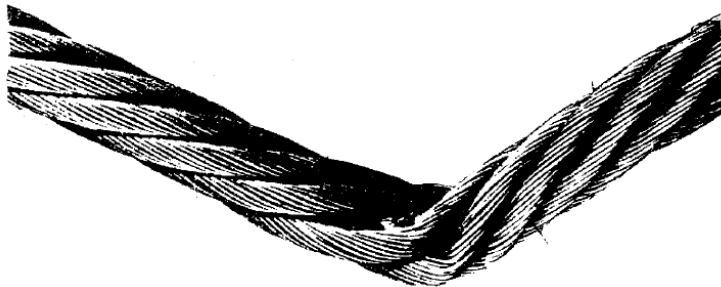


Fig. 6-60 Bends

18) Local decrease of diameter of the rope

A local decrease in rope diameter usually relates to a fracture of the core. As the figure below showing, local decrease of diameter of the rope shall be immediately discarded.



Fig. 6-61 Local decrease of diameter of the rope

19) Damage due to heat or electric arcing

Ropes that have been subjected to exceptional thermal effects, externally recognized by the colors produced in the rope, shall be immediately discarded.

6.10.6 Replace the rope

When the length of rope cannot meet the use requirements or reach the scrap standard, it should be replaced in time.

■ Procurement

- 1) To ensure the quality of the rope, it is recommended to purchase from the original factory of the main engine.
- 2) Rope tube should be used for storage and transport.
- 3) Correct handling of rope head.
 - Truncation should be done by cone-open fusing.
 - When conical fuse breaking is not possible due to limited conditions, it can be handled by tying steel wire and then cutting it off, but attention should be paid to:
 - 1) It is recommended to use medium 1mm steel wire binding, and as tight as possible.
 - 2) Binding length l should be $(2\sim4) d$, multiply rope should be large value.
 - 3) The distance between the two sides of the binding place should be 10~20mm.
 - 4) It is advisable to use gas cutting or electric welding to weld the end firmly after grinding.

■ Loading, unloading and storage

- 1) Loading and unloading

Loading and unloading should be done in the correct way, as shown in Fig. 6-62, Operation as shown in Fig. 6-63 should be rejected.

- The correct handling and unloading method

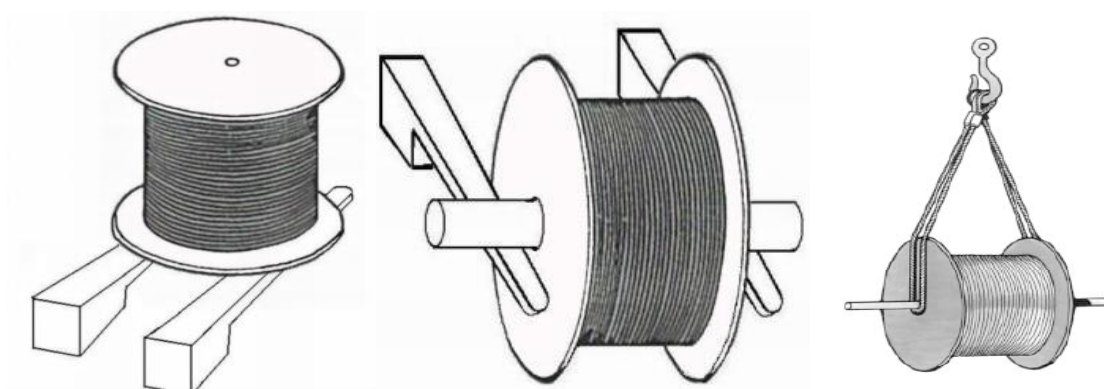


Fig. 6-62 The correct handling and unloading

- The wrong handing and unloading method

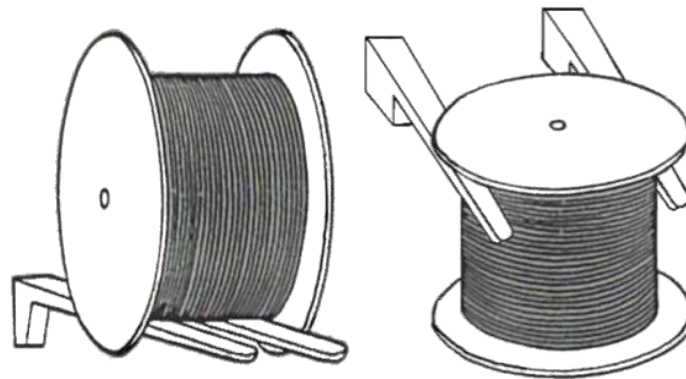


Fig. 6-63 The wrong handing and unloading

2) Storage

The rope should be properly kept to prevent rust or damage caused by damp. the requirements are as follows:

- The rope should be stored in a well-ventilated room, isolated from the damp ground, to prevent direct sunlight, hot air baking and grease dripping.
- Avoid contact with acid, alkali and other invasive materials.
- Avoid the rope from being squeezed and hit.
- It should not be stacked in the open air. If it must be stored outdoors, it should be placed on the dry ground with higher ground, and the air floor at the bottom is isolated and covered with a tarpaulin.
- The original information of each wind of wire rope must be kept completely.
- For the storage of rope for a long time, generally a yearly appearance inspection, rust, oiling, and then re-winding, to prevent improper storage of rope serious deterioration.
- The rope stored for more than one year can be used only after passing the qualification test before use.

■ Winding the rope

- 1) The out and in directions of rope drum and drum should be the same. (Fig. 6-64)

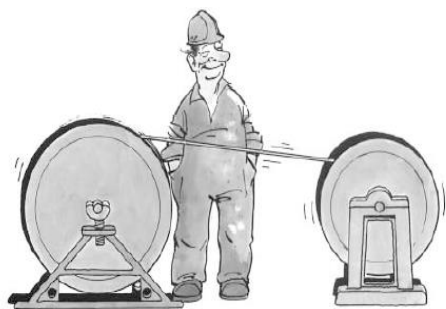


Fig. 6-64a Correct (Along the winding)



Fig. 6-64b Wrong (rewind the winding)

Fig. 6-64 Winding the rope

2) Rope pre-tightening

When the rope is wound out of the drum, resistance should be applied to the rope drum according to the site conditions and the principle as shown in Fig. 6-65 to prevent excess rope from being released.

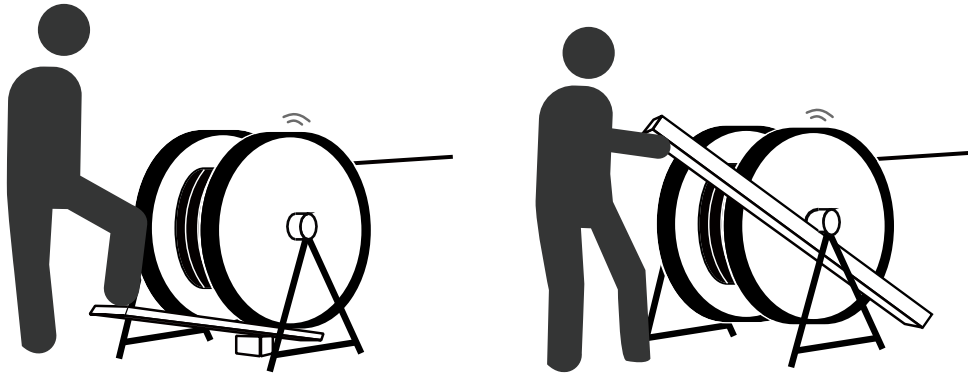
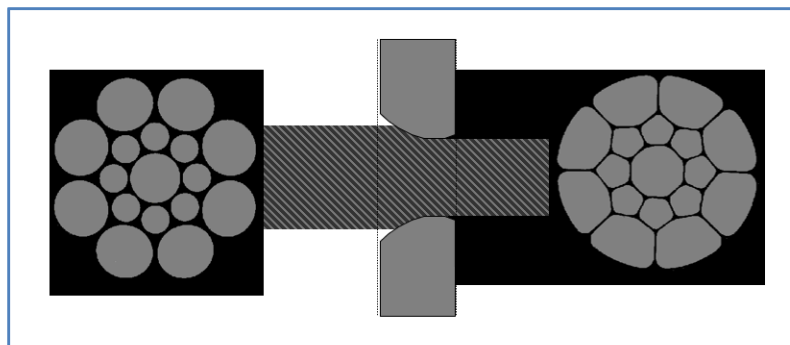


Fig. 6-65 Principle of rope pre-tightening

During rope wound into the drum, ensure that the tension of rope is not less than 1500N. If the site condition does not be met, the length of the rope should be controlled. At the maximum fall, the hook is in the lower limit, the rope allowance on the drum is generally not more than 2 layers.



When replacing the hoisting rope, user must configure the compactable rope in strict accordance with the specifications required by this manual. The wrong use of common (non- compactable) rope will cause rope fracture, resulting in serious consequences of crane destruction and death.



Non- compacting rope

Compacting rope

There is huge difference between compacting rope and ordinary non- compacting rope. The same diameter of compacting rope than non- compacting rope breaking pull is much larger, the service life is longer, please be sure to configure the compacting rope according to the requirements.

To guaranteed the quality of rope, please choose the original rope in the purchase of rope.

In addition, the following requirements must be met; (d is the theory diameter of rope)

- The minimum breaking tension of the hoisting rope and trolley rope shall be complied with requirements:
- The diameter allowable deviation of trolley rope is $d (+1\% \sim +5\%)$, unevenness $\leq 2\%$ and out-of-roundness $\leq 3\%$
- The diameter allowable deviation of hoisting rope is $d (+2\% \sim +4\%)$, unevenness $\leq 2\%$ and out-of-roundness $\leq 3\%$
- Anti-torsion performance of hoisting rope: torque coefficient $KQ \leq 0.021$, rotation degree $\leq 1.5r/1000d$;
- The lateral pressure stability of the hoisting rope: $\Delta V \leq 8\%$;
- The diameter shrinkage of the hoisting rope: $\leq 3\%$.

6.10.7 Maintenance of Rope

Maintenance of the rope should be relative to the crane usage environment and involved rope type. Paint lubricating grease and lubricating oil when installing the rope. The rope shall be cleaned where necessary, and the rope being reused in regular time interval, especially before the section of rope passing round the pulley shows signs of dryness or corrosion should be kept in good lubricating condition.

The rope lubricating oil (grease) should be Graphite calcium base grease ZG-SSY1405-65, it has strong penetration. A shorter working life of rope will result from lack of maintenance.

If wire rope grease on the surface dry, it should be cleaned in time, and apply new accord with the prescribed grease.

Wire rope surface should avoid applying too much grease. Surface blotted out too much grease may produce the following question

- 1) Aggravated deterioration of the rope rupture
- 2) Environmental pollution
- 3) Easy adhesion of the dust or other substances, make the wire rope from corrosion

6.11 Maintenance of pulley assembly

6.11.1 Examination of pulley assembly

Hoist pulley, trolley pulley, trolley and hook pulley are non-lubricating bearings. The pulley shaft has no oil nozzles and does not need to be lubricating,

- Daily inspection of bearings:
 - whether there is oil leakage
 - Shaft end seals
 - Elastic ring
 - Operation noise and resistance
 - Bearing clearance.
- Table of pulley parameters, Table 6-23

Table 6-23 Pulley parameters

Designation	Specification	Diameter (mm)	Rope groove depth (h)	Rope groove radius (R)
Hoisting pulley	360-300-B55-110-R7.5	360	22	7.5
Trolley pulley	214-178-B41-80-R6	214	18	6

6.11.2 Pulley scrap

The main forms of pulley damage are worn and extrusion of the pulley groove caused by the steel rope. Generally, the surface condition of the pulley groove (Fig. 6-66 and Fig 6-51), wear depth and arc radius are the basis for judging whether the pulley is normal or not.

- Surface condition of rope groove

The surface of the pulley groove should be worn evenly and smoothly. When there is obvious indentation, the pulley should be replaced.



Fig. 6-66 Example pulley indentation

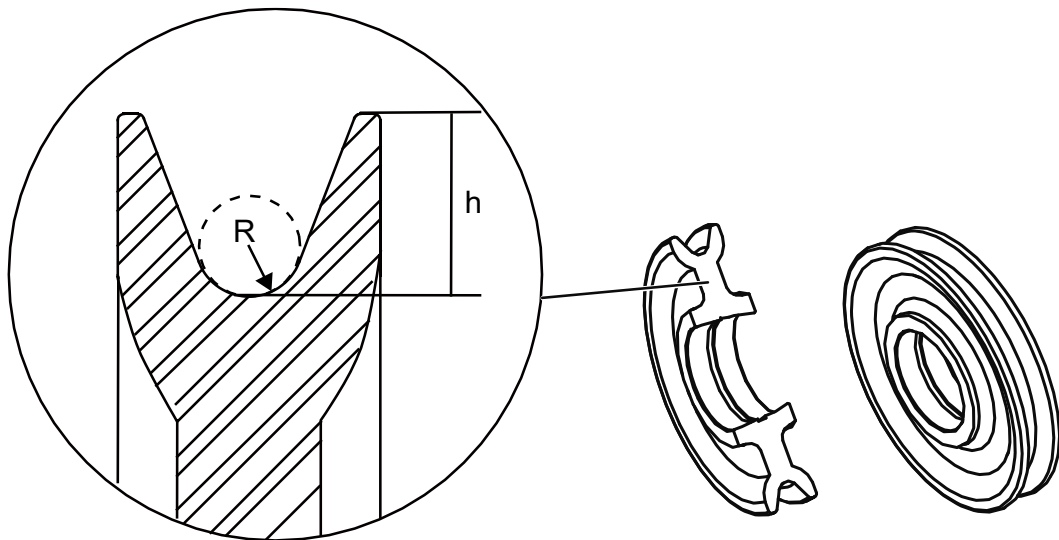


Fig. 6-67 Depth detection of rope groove

■ Depth of rope groove

Due to wear, the h value of rope groove depth increases gradually. For the hoist pulley, the pulley should be replaced when the value increases by 30% over the theoretical value. For the trolley pulley, the pulley should be replaced when the h value increases by 30% over the theoretical value.

■ Rope groove radius

- Due to wear, the radius R of the rope groove will change. when the value of R exceeds $0.525d \sim 0.6d$, the pulley should be replaced.
- The rope groove radius detection method as shown in Fig. 6-68
- The radius of the pulley grooves is detected by the pulley gauge or radius gauge (R gauge). From the beginning of the large diameter measuring tool to the arc of the measuring tool basically coincides with the arc of the normal section of the pulley groove.

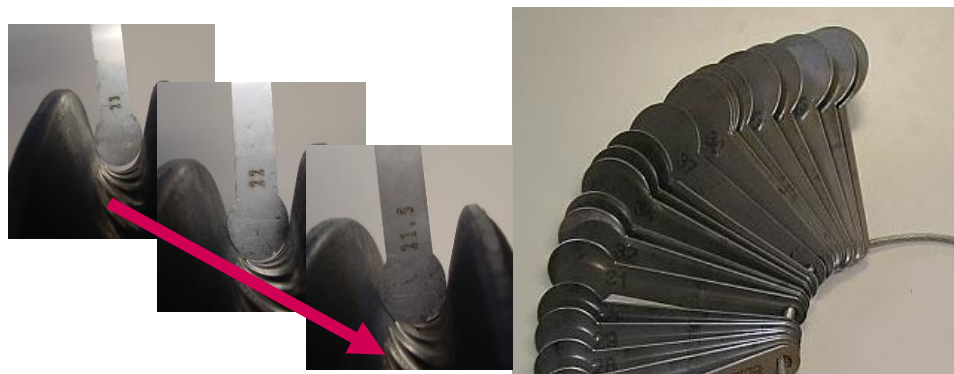


Fig. 6-68 Examples of radius detection of pulley groove arc

- When the pulley is found to have flange, crack and other phenomena, the pulley should also be replaced.

6.12 The high strength bolts

6.12.1 Basic knowledge of the high strength bolt

- There are many high strength bolts, they are used to connect the components and pass load.
- All the high strength bolts which are used to connect the components of the tower crane are vital for the tower crane and must be installed, maintained, and checked seriously.
- Check the high strength bolts occasionally, to assure the fastness and reliability of the connections. Looseness of the bolt may lead damage and even the stale connection of single component.
- If users choose the bolts by themselves, please ensure the strength grade of the nut can match the bolt.

For example:

8.8 grade bolt -> 8 grade nut;

10.9 grade bolt -> 10 grade nut

12.9 grade bolt -> 12 grade nut

6.12.2 Checking the bolts and bolt connection sets

Clean and check all the bolt connecting components before the installation. The checking contents include bolts, nuts, thread, the transition part between the bolt head and the screw and so on.



Using the damaged bolts and nuts is strictly prohibited! Don't use the bolts whose screws are rusty and the bolts or the nuts whose threads are rusty!

6.12.3 Lubricating the high strength bolt assembly

Use molybdenum disulfide to lubricate all the bolt assemblies before installing them. Good lubrication can supply uniform friction and standard preload for the bolt.



As is shown in Fig. 6 53 please lubricate the threads of the bolts and nuts and the contact surfaces. If the preload is exerted on the bolt head, the contact surfaces of the bolt head need to be lubricated as well.

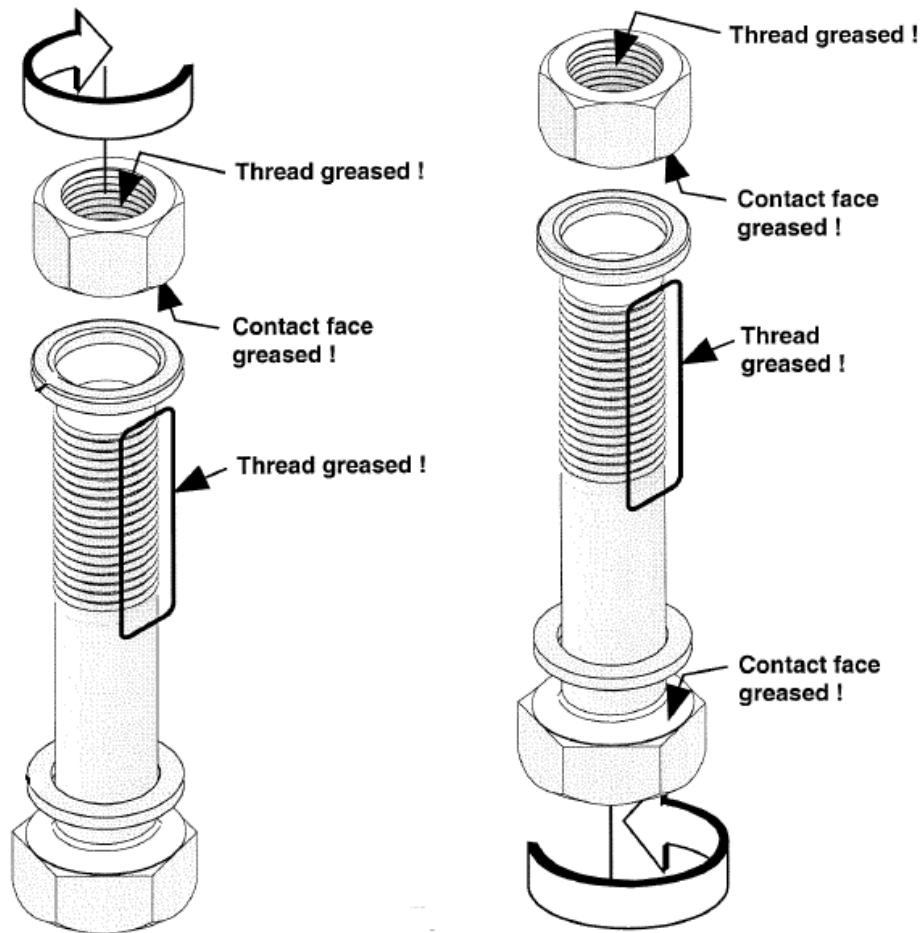


Fig. 6-69 Lubricate the contact surface

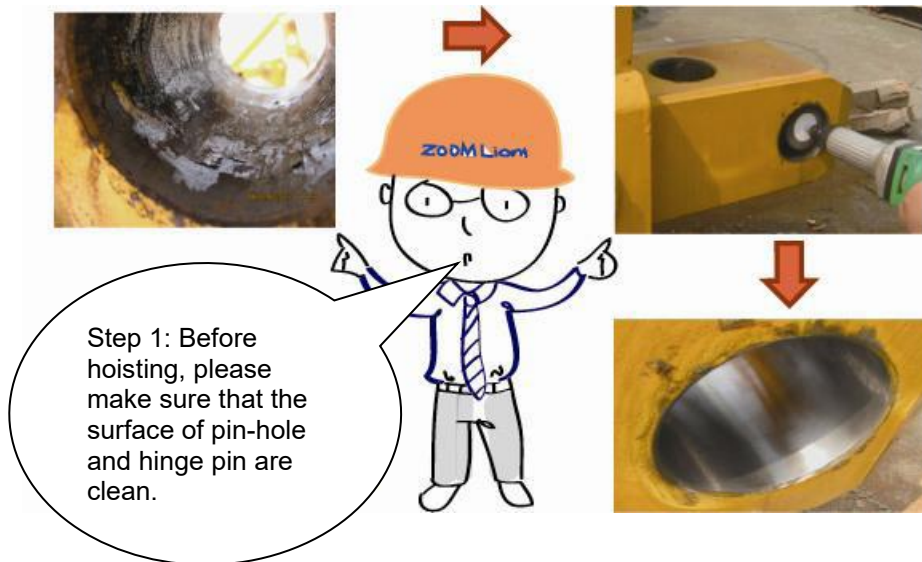
6.12.4 Recycling the high strength bolt

All the bolt assemblies which were exerted preload rightly can be recycled when erecting the tower crane again. However, all the bolt assemblies recycled must have been checked and are not damaged.

6.13 Pins and holes of the tower section

After assembling the tower section, please check the pins and holes as follow the steps.

- Before hoisting the tower section, please make certain that the surface of pin-hole and pin is cleaned. It can use the polisher to clear the pin-hole, but grinding wheel is prohibited which enlarges the pin-hole. After cleaning, the pin-hole should have mental luster.



- When installing the tower section, please check the pin-hole again and make sure there are no sundries, if there are any sundries please clear it.



- After cleaning the surface of pin-hole and pin, uniformly daubing the AG1 rusting preventive grease on the inner surface of the pin-hole and outer surface of hinge pin. Then installing the hinge pin. Strictly prohibit mixing the difference kinds of grease. Strictly prohibit mixing the new AG1 with old AG1.



- After dismantling, the hinge pins must be placed in the clean and waterproof box which should be placed indoors. If the pin-hole of tower section is rusting or the grease consolidation, firstly cleaning the pin-hole, then daubing the AG1 rusting preventive grease. It must have adapting cushion between the tower section and ground.



- Check if the rabbet of the tower section main chord can shake, if it can shake, the shake value cannot exceed 0.7mm, if it exceeds, please contact our company's after-sales staff to handle it before it can be used.

6.14 Hook

6.14.1 Check the locking of the hook

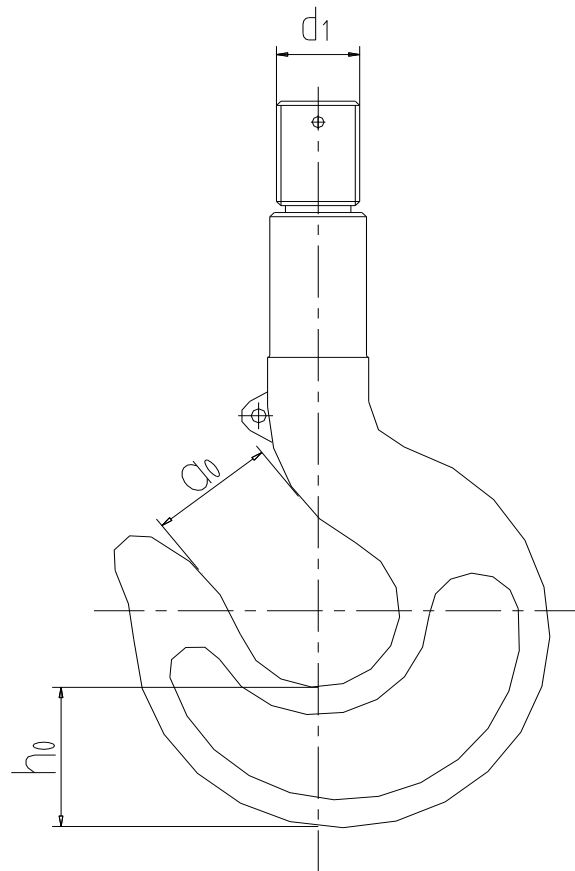
- All the fasteners of pulley pin and connecting pin are normal;
- The press plate on the hook nut is installed in place, without deformation, and the bolts on the press plate are firmly fixed; The tower crane needs to be checked before use. If the fixing bolt is loose or damaged, please tighten or replace the bolt in time.

6.14.2 Opening Degree of the Hook



Inspect the deformations at least once a month.

- The initial value of hook opening degree $a_0 = 112^{+6}_0 \text{ mm}$. (According to the measuring value before the first time use of the hook)
- If the opening degree has been more than 110% of the initial value a_0 , replace the hook.



- Check the torsion deformation of the hook. When the torsion angle of the hook body exceeds 10° , replace the hook.
- The handle of the hook should not be plastic deformation, otherwise it should be replaced

6.14.3 Wear

The initial value: $h_0 = 132$

The wear on hook may not be greater than 5% of the height "H". It is not permitted to carry out welding work on hook to repair the wear.



Check hook wear at least once a month.

■ Surface cracks



- If there are obvious distortions of the hook, do the surface cracks check to the hook using appropriate method or change the hook.
- Damages and surface cracks can be removed, but no gap can be left. The hook dimension after being removed the cracks and damages should not exceed the permissible tolerance.
- If the installed hook cannot be checked, dismantle it and check it.
- Before making checks, ensure that the surfaces are put into a condition permitting the definite identification of surface cracks!

6.14.4 Corrosion

- The diameter d_1 of hook handle cannot be corroded to be less than 95%, if the diameter is less than 95%, change the hook.
- The threads on the hook cannot be corroded.



Hook defects are not allowed to be repaired by welding.

6.14.5 Check hook anti-tripping device

- Hook anti-tripping device, under normal use, anti-rope device and hook can form a closed cavity. If the anti-tripping device and hook cannot form a closed cavity, the anti-tripping device shall be corrected. If it cannot be corrected, shall be replaced.
- If the anti-tripping device or the connecting pin between the anti-tripping device and the hook is deformed, which affects the normal use, please replace the pin.



The anti-tripping device should be check before the tower crane is used.

6.14.6 Oil hook bearing

Thrust ball bearing are used on the hook assembly, which are provided with lubricating oil holes and need to be lubricated regularly.

6.15 Trolley

6.15.1 Routine inspection of trolley rollers

- Check roller bearings;
- The roller rotates normally;
- There is no damage or deformation of roller;
- Roller wear;
- The nut and lock washer of the roller shaft are not loose;
- All the rollers of the trolley are in contact with the jib;
- In the process of running the trolley, the roller, the roller cover and the belly rod of the jib do not interfere

6.15.2 Routine inspection of side rollers of trolley

- Check the side roller bearings;
- The roller rotates normally;
- There is no damage or deformation of roller;
- Check the wear of side rollers (see Table 6-24 Side roller specification table); Replace the side roller when the wear of the side roller reaches 5% of the diameter

Table 6-24 Side roller specification table

No.	Order No.	Specification
1	000209705A0001400	Φ80-30
2	000209710A0600001	Φ120-50
3	000209716A0010019	Φ140-50
4	000209705A0001200	Φ150-50

- There is no damage to the split pin or clamp plate used for the limit of the side roller shaft, and it is firmly fixed

6.16 Steel structure

6.16.1 Foreword

This description contains the maintenance instructions for the steel structure elements of the crane.

6.16.2 Description

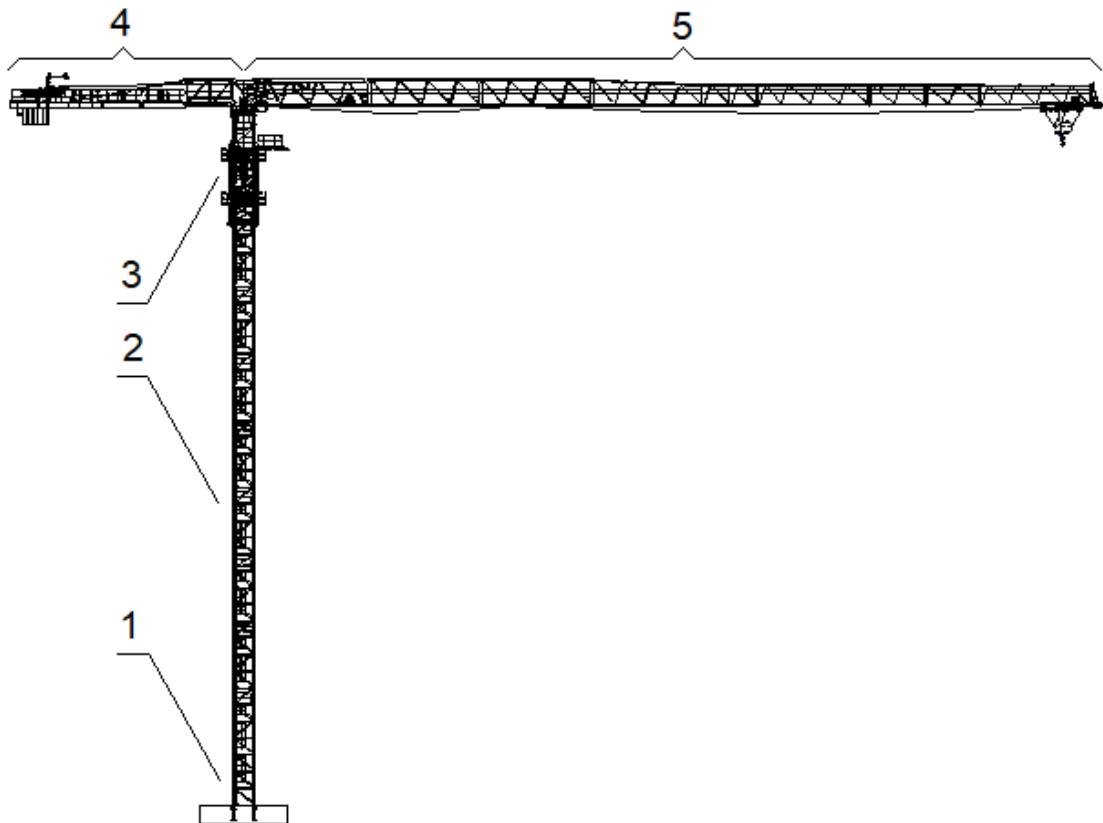


Fig. 6-70 Steel structure of the crane

- | | |
|------------------------|-----------------|
| (1) Outriggers | (2) Mast |
| (3) Climbing equipment | (4) Counter jib |
| (5) Jib | |

6.16.3 Description

The structure defines all the metallic parts constituting the crane steel structure.

General condition / appearance	■ Cleanness / cleaning ■ Paint / corrosion
Steel structure	■ Ballast ■ Derrick / mast / crane tower / jib / counter jib ■ Pins / screw bolts ■ Ladder / platforms / grab rails / catwalks / guard ropes ■ Lifting cab guiding system ■ Greasing

6.16.4 Maintenance

General condition / appearance

Check the general crane aspect: cleanness (concrete, mud, and sand splashes, etc...).



Cleanness and general correct appearance of the crane avoid risks and operating problems.

Cleanness / cleaning

The cleaning must be carried out with fresh water without detergent. Using a high-pressure apparatus is possible if the following instructions are observed:



Never apply the squirt directly on hinges, cables, safety devices and electrical equipment: control panel interior, cables, connectors, terminal strips, etc..

The control panel inside must be freed from dust by means of compressed air. Remove dust from the electrical equipment and the safety devices with a dry cloth.



After each cleaning all the required parts must be lubricated and greased.

Paint / corrosion

Carry out a visual check of the following points:

- In case of a drain line due to an invisible corrosion, carry out a regular check,
- In case of corrosion on a painted part, clean and grind the area, then apply a layer of rust preventing agent and paint,
- In case of wear of the surface treatment, clean and grind the area, then apply a layer of rust preventing agent and paint.

Steel structure

Carry out a visual check of the ballast concerning the following points:

- In case of cracks, fretting, too considerable wear, carry out a weighing in order to make sure that the ballast weight is still within the tolerance.



Tolerance of the ballast weight: 0 to + 4% (base) / -2 to +2% (counter jib).

- In case of corrosion on the metallic ballast, clean and grind the area, then apply a layer of rust preventing agent and paint,
- In case of a drain line due to invisible corrosion carry out a regular check,
- In case of wear of the hoisting loops or their fixings to the ballast blocks including the risk of a break, replace the ballast.

Derrick / mast / jib / counter jib

Carry out a visual check on the whole crane steel structure (deformations, cracks, damages, ...).



The crane steel structure is an essential part. As soon as an anomaly is detected: cracks, crackled paint, deformation, anomalous noise, compulsorily stop the crane operation and contact a ZOOMLION expert.

Deformations:

- Deformation of the steel structure



- Deformation of a bracing



- Pressure, sinking



- Friction



Pins / screw bolts

Carry out a visual check on all assembling points of the parts constituting the crane.



Assembling by fish joints, pins and screw bolts is of highest importance. As soon as an anomaly is detected, stop the crane operating and solve the problem.

■ Pins



■ Screw bolts.



Ladders / platforms / grab rails / catwalks / guard ropes

Carry out a careful visual check of all welding on the whole crane.



All the accesses must compulsorily be present, correctly fastened, and free.

6.17 Maintenance of electronic control system

The electronic control system should be frequently maintained and maintained to eliminate faults, eliminate safety hazards, ensure the normal operation of the whole crane, and extend the service life of the equipment. Maintenance work should be carried out by professionals with relevant qualifications.

6.17.1 Electrical equipment inspection

Table 6-25 Checklist of electrical equipment

Inspection cycle	Inspection item
Daily operate before inspection	Electrical Equipment: Whether the door of the electric control cabinet closes The air switch in the cabinet Circuit breaker Display Electric whistle Sensor Over load display Moment percentage display Trolley position display Hoisting height display Wind speed display Weathervane brake release
	Indicator light/indicator device: Voltmeter Overvoltage indicator light Cab light Beacon light
Check each erection and inspection cycle (suggest cycle is 2-3 weeks)	Main power Main power switch box Phase sequence Service voltage Length and shuck of main cable Every position for reliable earthing
	Cable: Meet a criterion Shuck of main cable in perfect condition, good insulation Plugins in correct location, good contact and reliable Cable stress relief.
	Electrical device: Air switch Circuit breaker Electric relay, contactor

Inspection cycle	Inspection item
	Display Sensor Over load and moment alarm normal Brake, weathervane brake External equipment connector good contact and reliable
	Indicator light/indicator device: Voltmeter Overvoltage indicator light Cab light Beacon light
	Electric control cabinet Temperature switch and humidity switch set values correctly Power voltage control set values correctly

- The inspection of electrical equipment must be carried out under no-load conditions:
 - The hook moves up and down slowly;
 - Trolley slowly moves outwards and inwards;
 - The tower crane slowly rotates to the left and right;
 - All control parts run correctly and smoothly,
 - The position of the trolley and the height of the hook on the display screen are displayed accurately and continuously.
 - The wind speed display value on the display is correct and reasonable
 - The mechanism starts quickly and smoothly,
 - Increase and decrease gears, continued, no gears, skipping, and the operating handle can automatically return to the zero position,
 - When running in no-load, there is no obvious special noise or vibration
- Check of component setting value

Temperature sensor (ST) and humidity sensor (SRH) in the hoisting and power cabinet, voltage monitoring relay, as shown in the figure below.

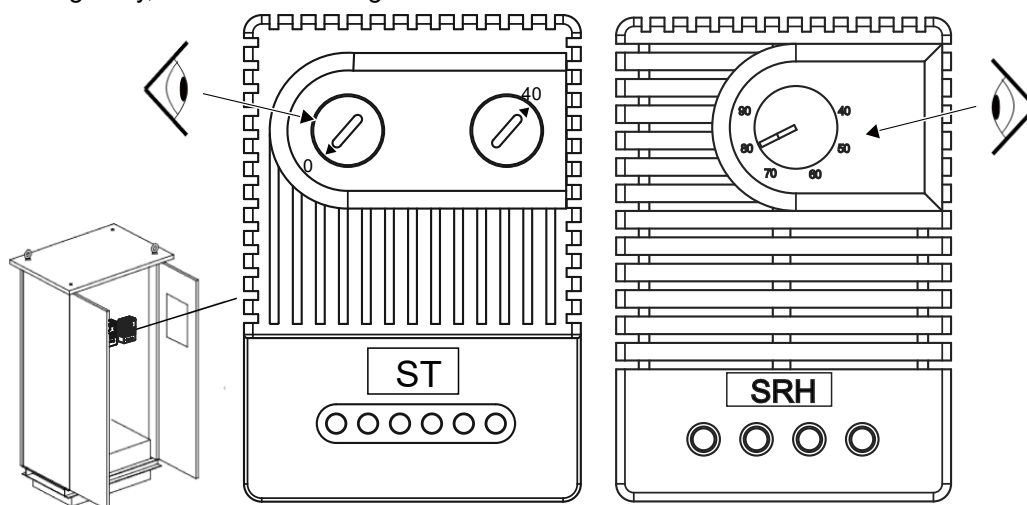


Fig. 6-71 Temperature switch and humidity switch in the hoisting and power cabinet

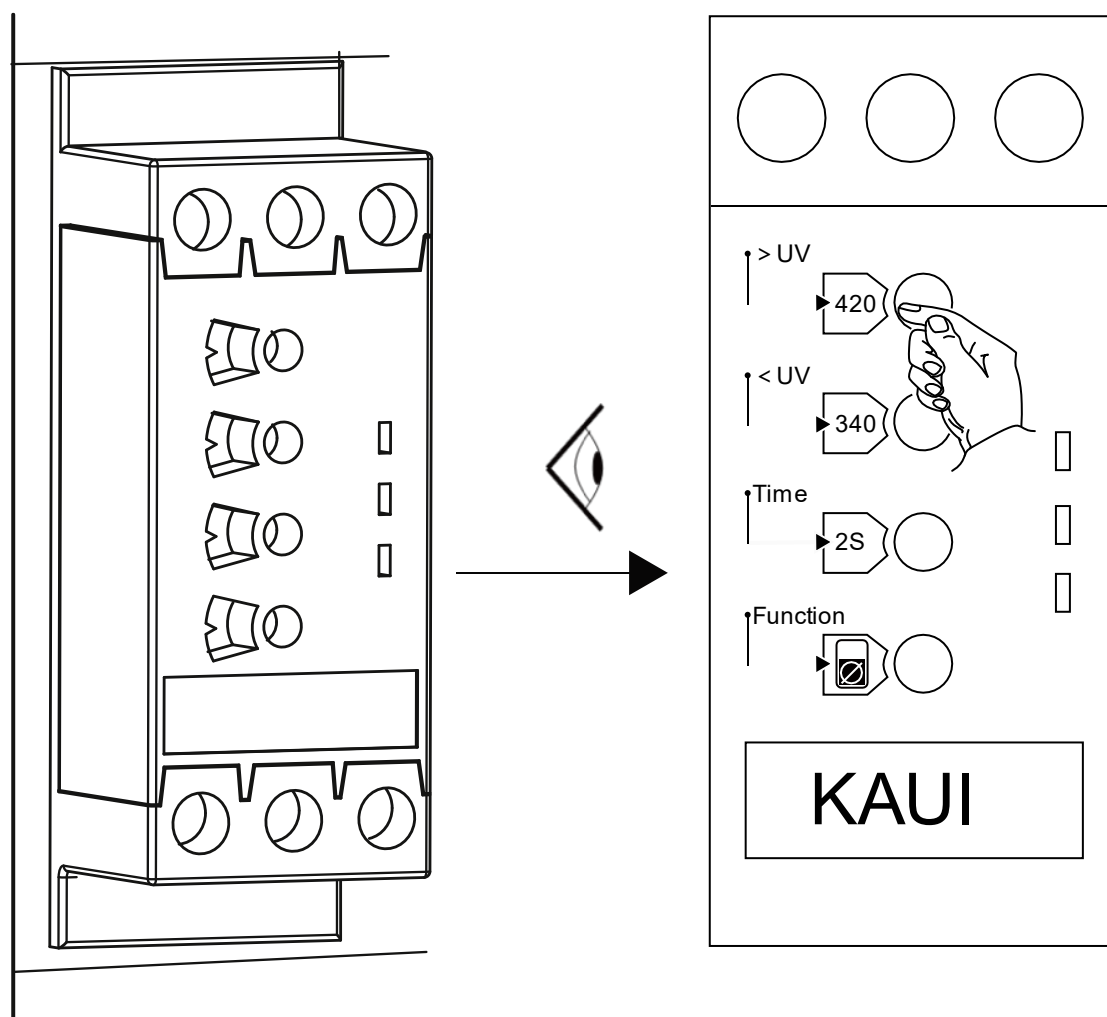


Fig. 6-72 Check set value of main control cabinet monitor electric relay

Table 6-26 Check detailed list for safety device

Code	Definition	Setting value
ST	Coating fan temperature	+40°C
	Heater working temperature	0°C
SRH	Heating humidity RH	+80%
KAU1	Overvoltage protection value(>U)	420V
	Undervoltage protection value(>U)	340V
	Delay time	2S
	Operating mode	☒ Reset delay + no phase sequence monitoring

6.17.2 Maintenance for cabin

- Check if the wiper is well, glass is clean, or the vision is clear;
- Check if there is proper fire extinguisher in the cabin;
- Check if the functions of the operating panel in the cabin are well;
- Check if all the electrical components in the cabin are well connected.

6.17.3 Maintenance for safety device

Every limiter and sensor require to calibrate and recalibrate definite value during every erection.

Table 6-27 Check detailed list for safety device

Inspection cycle	Inspection item
Daily operate before check	Location of limiter: Maximum trolley position for trolley (jib length); Minimum trolley position for trolley; Upper stop position for hook; Hook stop position at bottom according require;
	Load capacity/moment limiter: over load alarm for load limiter, load moment;
Check each erection and inspection cycle (suggest cycle is 2-3 weeks)	Location of limiter: Maximum trolley position for trolley (jib length); Minimum trolley position for trolley; Upper stop position for hook; Bottom stop position for hook;
	Load capacity: Check the accuracy of the load capacity display (Hoist the known load); Check the accuracy of mechanism load limiter is triggered Check the accuracy of mechanism moment limiter is triggered (constant load for variable radius, constant radius for variable load); Check the percentage accuracy of mechanism moment limiter display (Take the mechanism moment limiter for refer);
Out of inspection cycle	Every mechanism requires to recheck and recalibrate when change hoisting rope, trolley, hoisting mechanism, trolley mechanism, load sensor and other relevant safety parts.
	Recalibrate if the jib change length
	Recalibrate after climbing operation

6.18 Spare parts list

6.18.1 Spare parts list of mechanism

Spare parts list of hoisting mechanism

No.	Order No.	Designation	Code	Install position	Qty
1	1020005145	Motor	TCA355L-8	H200FL160-1150D (000209195A1550000)	1
2	000209944A0 000570	Coupling	MLL12-I-500- ZA110×167(25)/JA10 0×167(28)		1
3	000209944A0 000262	Elastomer	MT12-b		1
4	1039905411	Brake	YWZ501-500/300- II A-WC.RL.HL		1
5	1039905232	Puller	YTD3000-60		1
6	1039809331	Brake shim	E3-500-200×14		1
7	1030203126	Reducer	MB3H150HB45BT		1
8	1090101583	Rope	GS-K34-30-1960		/
9	1021500637	Hoisting limiter	DXZ1:360B0×20		1

Spare parts list of trolley mechanism

No.	Order No.	Designation	Code	Install position	Qty
1	1020000169	Motor	YVFE200L1-6B5- 18.5kW	T185FC80 (000209370A1900000)	1
2	1031700496	Coupling	DDZ-300F		1
3	1030200664	Reducer	XX5-180.85		1
4	000209370A1 900010	Coupling			1
5	000209333B0 000062	Nylon gear ring			1
6	000209333B0 000150	Pinion			1
7	1090101542	Rope	6×29Fi+IWR-16-1960- ZS		/

Spare parts list of slewing mechanism

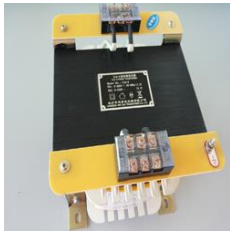
No.	Order No.	Designation	Code	Install position	Qty
1	1020005515	Motor	YTRVF180L1-4F1/D	S185CA- 350.275CD20/13B (000209289A1050000) S185CN- 350.275CD20/13B (000209289A1090000)	1
2	1029805170	Vane brake	DDZ-80DFB		1
3	1031700208	Brake	DDZ-80		1
4	1030202901	Reducer	XX5-350.275CD-20/13		2
5	1020005516	Motor	YTRVF180L1-4F2/D/BM1		1
6	1020202072	Encoder	ECK58B(Nr:851249/10)		1

6.18.2 Spare parts list of electrical control system

Table 6-28 Spare parts list of electrical control system

No.	Order No.	Designation	Code	Picture	Qty
1	1020499217	Horn	TLM-60-5m		1
2	1020104348	Controller	CR720S		1
3	1022001015	Phase monitor	CM-PFE		1
4	1020099258	Frequency converter	ACS880-04-585A-3+D150+E208+N7566		1

No.	Order No.	Designation	Code	Picture	Qty
5	1020303114	Relay	AHN22324		10
6	1020304036	Relay seat	AHNA21		10
7	1020499181	Solar obstacle light	BO-720		3
8	1020702069	Voltmeter	OB-72-V (500V, with cover)		1
9	1020404616	Indicator light	AD17KA-22/AC220V Y		1
10	1020099026	Frequency converter	ACS880-01-169A- 3+D150+N7566		1
11	1020099260	Frequency converter	ACS880-01-061A- 3+N7567		1

No.	Order No.	Designation	Code	Picture	Qty
12	1029908019	Bus card	FCAN-01		1
13	1029907207	Expansion card	FEN-31		1
14	1021901075	Transformer	ST52		1
15	1021901027	Transformer	ST17		1
16	1020901019	Switch power	DRP-240-24		1

6.18.3 Spare parts list of structure

Table 6-29 Spare parts list of structure

Location	Designation	Order No.	Code	Qty
Jib	Pulley	000209906A0013000	400-340-B55-110-R8.5	2
Jib, trolley, hook	Pulley	000209716A0010010		9
Trolley	Roller	000209711B0000119		8
Trolley	Hoisting rope roller	000209711B0000270		3
Trolley	Trolley rope roller	000209721F0101008	22220C	2
Trolley	Side roller	000209716A0010019	6314-2RS	8
Trolley	Buffer	000209704A1200001	6208-2RS1	6
Trolley	Deep groove ball bearing	1050202165	6314-2RS(GB/T276-1994)	16
Trolley	Retainer ring	1040300680	150(GB/T893.2-1986)	16
Trolley	Deep groove ball bearing	1050201563	6208-2RS1(GB/T276-1994)	6
Trolley	Bearing	1050201944	6206-2RS(GB/T276-1994)	8
Trolley	Self-aligning roller bearing	1050200454	23024CC/W33 (GB/T288-1994)	8
Trolley	Retainer ring	1040300644	180 (GB/T893.2-1986)	8
Hook	Self-aligning roller bearing	1050200326	22220C (GB/T288-1994)	2
Hook	Metal seal ring	000209711B0000118		2
Moment limiter	Switch box	1020521047	LJ-D2-K	1

6.19 Appendix troubles and troubleshooting

Common troubles and troubleshooting of the crane

No.	Trouble	Troubleshooting	Solution
1	The temperature of the reduction reducer is too high.	a) Excessive lubrication oil b) Oil is old-fashioned c) Oil is grievously polluted	a) Check the oil surface, adjust the height if necessary. b) Figure out the time of last oil change, change oil if necessary. c) Change the type of oil.
2	The temperature of the reduction reducer bearings is too high.	a) Excessive or deficient grease. b) Poor grease quality. c) Improper axial clearance of the bearings or bearings is already damaged.	a) Properly replace grease b) Re-adjust the bearing clearance c) Replace bearings
3	Oil leakage from reduction reducer	a) Leakage from the input and output shaft end of the reduction reducer. b) The strainer of the air cleaner is blocked. c) The sealing rings of end covers or the matching surface is sabotaged.	a) Replace sealing rings. b) Clean the strainer. c) Reseal.
4	No output from the pump station/ cannot be adjusted to rated pressure/ the pressure is not steady.	a) The rotary direction of the motor is wrong. b) The escape valve is blocked by unclean oil. c) Tube leakage. d) Pipe connections become flexible. e) The sealing parts of the pipe connections are broken. f) Coarse strainer is blocked. g) The pump station is damaged by long-time over load.	a) Check the line of the motor. b) Remove the main valve and clean it with kerosene. c) Remove the pipe and weld the broken part or exchange it. d) Screw the pipe connection. e) Exchange the seal washer. f) Clean the strainer. g) Exchange the pump station.
5	Climbing mechanism motor does not rotate when	a) Terminals and breakers be loosed. b) The breaker tripped or burned by overload or short circuit	a) Check the line and rewire the circuit by electrical schematic diagram b) Repair or replace the

No.	Trouble	Troubleshooting	Solution
	power on		breaker by checking the contacts and electromagnetic trip;
6	Climbing speed is too slow	a) Worn oil pump, declined efficiency b) Oil in the tank is insufficient or oil filter clogged c) Hand-operated valve rod and valve hole severely worn d) Oil cylinder piston seal is damaged and internal oil leakage.	a) Repair or replace the damaged parts b) Fill adequate oil or clean oil filter c) Exchange the hand-operated valve or the worn parts. d) Reseal the oil cylinder piston.
7	Climbing force is not adequate or unable to jack	a) Severe internal leakage from oil pump b) Overflow valve pressure set too low c) Hand-operated valve core excessively worn d) Overflow valve clogged down	a) Repair or replace the worn parts b) Adjust pressure as required c) Clean hydraulic valve. d) Exchange overflow valve.
8	Noise and vibration occur during climbing operation at increasing pressure	Oil filter clogged	Clean oil filter
9	Climbing unit is not working	Motor rotation and oil pump rotation both in wrong directions	Change motor rotation direction
10	Creeping and quivering during climbing operation	a) Air not completely exhausted from oil cylinder piston b) Trouble with guide mechanism	a) Exhaust air as required. b) Adjust guide pulleys
12#	Adjust guide pulleys	Trouble with guide mechanism	Exhaust air as required.
11	Climbing drop when loaded	a) There are troubles with balance valve of the cylinder head. b) Piston sealing of oil cylinder is damaged	a) Remove trouble b) Replaces sealing parts
12	No response from crane when start button	a) Power supply is break wrong phase led to Phase Sequence Relay action, or phase-sequence	a) Check if power supply quality and Phase Sequence Relay is good

No.	Trouble	Troubleshooting	Solution
		relay action is caused by power mis phase, or power supply is abnormal, causing the operation of the voltage monitoring relay b) Console zero switch is broken; c) Breaker QF, etc. trip; d) Contactor KMC not fit; e) Power-off; f) Emergency stop button (locate in the right console and side of main control cabinet) not reset; g) The loose aviation plugs below the console or the plug had been fallen.	b) Repair or change It; c) Switch on again; d) Repair or change it; e) To solve on the site; f) Turn the emergency stop button clockwise, make it reset circuit; g) If the plug loose, screw up it; The falling plug cannot indiscriminate, installing the plug according to the installed groove;
13	Response from crane when start button, but cannot start normally	a) The wrong power phase Sequence; b) Power lack phase (The circuit breakage or burn out insurance); c) The bad quality of phase Sequence Relay action and undervoltage Relay action; d) The setting voltage range is wrong from the of undervoltage Relay action; e) The bad quality of power;	a) Check the power phase Sequence or after turn off the total power supply on the box, any replacement the two position of U2, V2, W2; b) Contact the site to solve and replace insurance; c) Replacement; d) Adjust voltage on the undervoltage Relay action; e) Check the power;
14	After pressed the start button, the buzzer is ringing, the handle no any reaction	Batteries in programmable Logic Controller is about to use up (life span is usually 5 years)	Inform the company rapidly to change it
15	The instability after starts the crane, total contactor pops up again and again	a) The instability performance of phase Sequence Relay action or the undervoltage Relay action setting voltage range is wrong; b) The instability power supply on the site (insufficient or lower approximate value of power), (start the motor, measure the voltage value from the total power supply with the multimeter, vary greatly).	a) Adjust voltage of the undervoltage Relay action or Replacement; b) If the power insufficient or lower approximate value, improve and increase the power supply; If the power sufficient, then it needs to increase the wire cross section or shortened guide

No.	Trouble	Troubleshooting	Solution
		The Power sufficient (start the motor, measure the voltage value from the total power supply with the multimeter, very little); Aviation plug is loose, cause the bad start circuit contact.	distance. c) Check each join point of the aviation plug, if it is loose, tighten it.
16	The leakage switch trips	a) Leakage switch (include total leakage switch, three-level leakage switch) problem; b) Motor insulation is damaged or Short circuit in the interturn c) The wear cable (Cut off the total power supply, leakage switch still trips); d) Leakage protector selection is too small;	a) Replace the leakage switch, use formal manufacturer's switch; b) Repair motor; c) Check each cable, especially the cable at the slewing; Whether there is damage and grounding of main cable, Whether the insulate layer of cable join is damage; d) Replace the leakage protector with larger capacity;
17	Hoisting mechanism cannot start	a) Frequency converter internal protect; b) Rotary encoder connection wire loose; c) Load limiter, moment limiter and Hoisting limiter cause;	a) Cut off power, wait 1 minute and try to restart; b) Check the situation of wire; c) Check Whether the limiters wire correct, reduce load capacity;
18	Slewing atony or Slewing static	a) Brake not open; b) Leak of oil in the coupler; c) Motor damage; d) The wind is strong and runs against the wind; e) Slewing circuit breaker QFS trips; f) The damage of control parts; g) Rotary encoder connection wire loose; i) Frequency converter damage; j) Left(right) stop limiter trigger;	a) Dismantling and check, observe whether the brake is open and remove stoppage; Check whether the contactor KSB movement; b) Filling regulation model oil for coupler; c) Replace the motor; d) When the wind is weak or downwind movement; e) Re-closing switch; f) Replace; g) Check the situation of wire; i) Replace;

No.	Trouble	Troubleshooting	Solution
			j) Reverse turn.
19	Noise and vibration occur to trolley mechanism	a) Friction between stator and rotor. b) The shaft of the motor and the shaft of the gear box is not concentric. c) Bearings are in oil deficiency or broken. d) Gear box is in oil deficiency. e) Gear friction. f) There are abnormal noises during two-phase performance.	a) Check the uniformity of the clearance between stator and rotor. b) Check the concentricity. If it is too large, adjust it. c) Check the circumstance of the bearings. If they are broken, exchange them. If they lack oil, refuel the corresponding oil. d) Refuel the stated oil. e) Exchange the gear. f) Cut off the power and fix it.
20	The temperature of the bearings in trolley mechanism is too high.	a) The bearings are broken. b) The grease is deteriorative or of bad quality or too few.	a) Exchange the bearings. b) Clean the bearings and exchange the grease.
21	The trolley mechanism is Charged.	a) The power line or the ground connection is wrongly connected. b) Defective grounding. c) The line of the motor is broken and grounding.	a) Check the connection. b) Make sure that grounding condition is well. d) Figure out and adjust.
22	The brake of the trolley mechanism is out of service.	a) The brake torque is too low. b) The clearance of the brake plate increases.	a) Exchange the brake spring b) Adjust the clearance.
23	The motor of the trolley mechanism is smoking or of high temperature.	a) Overload. b) Continuous load or irregular working. c) The two phases are far away. d) The voltage is too low or too high. e) Motor winding is earthed or cutting-out f) The clearance between friction plates is wrong g) The time of braking and releasing is wrong.	a) Measure the current of the stator. If it is over rated figure, reduce load. b) Operate under order. c) Measure the three-phase current and clear troubles. d) Check the input voltage and clear troubles. e) Figure out reasons and clear troubles. f) Adjust the clearance based on regulation.

No.	Trouble	Troubleshooting	Solution
		h) The air gallery of the motor is blocked, so the temperature rises. i) The brake is opened unthoroughly or is closed so that the motor is unmoved and emit heat.	g) Check the voltage of the brake and the movement time of delay time chopper, then clear troubles. h) Unblock the air gallery i) Adjust the brake under regulation.
24	The bad rope pay-off of drum and rope jumping	a) Poor lubrication of the guide pulley causes the pulley stuck and unable to play a good guiding role; b) The upper layer rope of on the drum is pressed into the lower layer;	a) Check the lubrication of the pulley, if the grease is found to be dry, remove it manually, and then apply the new grease; If the ambient temperature is too low and the grease is too dry, add dilute oil to the pulley (check every day, and add dilute oil if necessary); b) Check whether the first layer of steel rope is tight. If not, the first layer rope must be tight, as far as possible with a certain load (2% of the minimum breaking pull of rope or 10% of the current rated hoisting weight) to pay-off rope 2%;
25	The circuit breakers trip frequently	The rate current of the switch is too small	Replace with a larger switch
26	The crane started unstable; the total contactor pops out repeatedly.	a) The performance of the phase sequence relay is unstable or the voltage range on the phase sequence relay is incorrectly set; b) The power supply at the site is unstable: The power supply at the site is insufficient or small (when starting the motor, the multimeter is used to measure the voltage fluctuation at the total power supply, which changes greatly); The power supply at the site is sufficient (when starting the motor,	a) Adjust the voltage of the phase sequence relay or replace it directly; b) If the power supply of the site is insufficient or small, the site shall be required to improve the power supply the power supply, if the power supply at the site is sufficient, it is necessary to increase the section of the wire or shorten the distance of the wire; c) Check the connecting

No.	Trouble	Troubleshooting	Solution
		use a multimeter to measure the voltage fluctuation at the total power supply, the changes is very small) c) The aviation plug is loose, so that the general starting line is in poor contact.	points of the aviation plug, and tighten them if they are loose.
27	The hook of tower crane with power	There were Electromagnetic transmission tower in the vicinity	Please use Nylon hoist with Standard
28	No hoisting	a) Limiter (Hoisting, moment, load) does not properly connect to the circuit b) Cooperative console bad connected to the PLC c) PLC's input point damaged d) Contact of Cooperative console damaged e) Relay fault f) Inverter fault	a) Rewire the limiter circuit b) Rewire the circuit c) Repair or replace the PLC d) Repair or replace the cooperative console e) Repair or replace the relay f) Repair or replace the Inverter
29	Lighting has no high speed	a) The command of the Cooperative console is incorrect b) 50% Weight limit c) The loose of KHH let the KHB remain open	a) Check the contacts of the Cooperative console; check the input of the PLC b) Check the contactor of the limiter c) Replace the KHH
30	Cannot turn left or right slewing	a) Slewing limiter; b) Cooperative console bad connected to the PLC; c) Inverter fault; d) Motor rotators damage; e) The two slewing motor wiring faults; f) Slewing circuit breaker QFS trip; g) The damage of control parts; h) Rotary encoder connection wire loose; i) Left(right) stop limiter trigger; j) Brake not open;	a) Adjust and check the slewing limiter and circle; b) Check whether the nut of the switch connector is loose; d) Dismantling the string of rotators, still turning, rotators string cutting-out; When there is a big gap between the rotators three-phase voltage and the nameplate voltage, repair the motor rotators or replace the motor; e) Replace the Phase Sequence of the reverse movement motor power circle

No.	Trouble	Troubleshooting	Solution
			wire; f) Re-closing switch; g) Replace; h) Check the situation of wire; i) Reverse tur; j) Refer the principal picture, check the circle of the brake;
31	Contactors cannot fit	a) Contactor circle exist 220V; b) Contactor circle without 220V;	a) Replace contactor; b) Check whether the interlocking contactor breakover, replace contactor if cannot breakover;
32	Slewing has not high speed	a) Wrong setting of the Inverter; b) Slewing limiter trigger;	a) Adjust the frequency of the Inverter; b) Check slewing limiter
33	Slewing cannot brake	No braking when power off No braking even normal operation a) KSB cannot fit normally; b) Electromagnetics brake excessive gap; c) Electromagnetics brake No magnetic force; d) The rectifier module is damaged there is no output voltage;	a) Repair or replace the contactor KSB; Repair or replace the console cable; Replace slewing brake switch; b) Adjust the gap of the Electromagnetics brake; c) Replace electromagnetics brake; d) Replace rectifier module;
34	Trolley stop running	a) The limiter or corresponding line is damage; b) Input of console to PLC without normal breakover; c) Console contact point damage; d) PLC fault; e) Trolley brake cannot open, Incorrect brake gap f) The circle of the brake cable without contacts and disconnect; g) Main contact point of KVB contactor damage; h) There is AC input but no DC input in the rectifier module;	a) Adjust limiter or check the circuit; b) Reconnect the circle wire or replace the air cable; c) Replace or repair the console; d) Replace or repair the PLC; e) Adjust the gap of trolley brake to 0.8~1mm; f) Reconnect the cable of electromagnetics brake; g) Move the KVB contactor main point; h) Replace the rectifier

No.	Trouble	Troubleshooting	Solution
			module;
35	Trolley has not high speed	a) Torque limited b) Trolley limited c) Cooperative console fault	a) Reduce the lifting weight b) Normal work c) Check the Cooperative console
36	Noise occurs to trolley mechanism	a) The bearing damage; b) Rope interferers with pulley arc rope rod; c) The slight interferers between cover(roller) and jib;	a) Replace the bearing; b) Adjust the rope rod or avoid interferers or remove rope rod and re-welded it; c) Replace the shorter rollers locating sleeve;
37	Hook head cannot rotate 360°	a) The bearing damage; b) There is mud between the nut and beam, increasing friction the nu; c) Bearing installed opposite;	a) Replace the bearing; b) Clean the mud between the nut and beam; c) Installed bearing correctly;

(2) Common troubles and troubleshooting of **Huichuan** frequency converter

No.	Trouble	Troubleshooting	Solution
02#	Accelerated overcurrent	a) The input circle of frequency converter exists grounding or short circuit; b) The control mode is parameter identification without vector; c) Accelerated time too short; d) Manual torque lift or V/F curve unsuitable; e) Low voltage; f) Start the point that is being rotated; g) Sudden loading during acceleration; h) Frequency converter selection is small;	a) Troubleshooting peripheral faults b) Click parameter identification; c) Prolong accelerated time; d) Adjust the manual torque lift or V/F curve; e) Adjust the voltage to normal range; f) Start speed tracking up or motor stop; g) Cancel sudden loading; h) Choose a more powerful frequency converter;

No.	Trouble	Troubleshooting	Solution
03#	Decelerate overcurrent	a) The input circle of frequency converter exists grounding or short circuit; b) The control mode is parameter identification without vector c) Decelerate time too short; d) Low voltage e) Sudden loading during deceleration; f) Frequency converter selection is small;	a) Troubleshooting peripheral faults; b) Click parameter identification; c) Prolong accelerated time; d) Adjust the voltage to normal range; e) Cancel sudden loading; f) Choose a more powerful frequency converter;
04#	Constant speed overcurrent	a) The input circle of frequency converter exists grounding or short circuit; b) The control mode is parameter identification without vector c) Decelerate time too short; d) Low voltage d) Sudden loading during operation; e) Frequency converter selection is small;	a) Troubleshooting peripheral faults; b) Click parameter identification; c) Adjust the voltage to normal range; d) Cancel sudden loading; e) Choose a more powerful frequency converter;
05#	Accelerated overvoltage	a) Input voltage high; b) During the acceleration, external forces drag the motor to run; c) Accelerated time too short; d) No brake unit and brake resistance;	a) Adjust the voltage to normal range; b) Cancel the additional force or add brake resistance; c) Prolong accelerated time; d) Add brake unit and resistance;

No.	Trouble	Troubleshooting	Solution
06#	Decelerate overvoltage	a) Input voltage is high; b) During the deceleration, external forces drag the motor to run; c) Decelerate time too short; d) No brake unit and brake resistance;	a) Adjust the voltage to normal range; b) Cancel the additional force or add brake resistance; c) Prolong decelerate time; d) Add brake unit and resistance;
07#	Constant speed overvoltage	a) Input voltage is high; b) During the deceleration, external forces drag the motor to run;	a) Adjust the voltage to normal range; b) Cancel the additional force or add brake resistance;
08#	Control power damage	a) Input voltage is out of regulation arrange;	a) Adjust the voltage to normal range;
09#	Undervoltage damage	a) Instantaneous power failure; b) frequency converter input voltage is out of specified range; c) Bus voltage is abnormal; d) The rectifier bridge and buffer resistance are abnormal; e) Abnormal drive board; f) Abnormal control board;	a) Reset the fault; b) Adjust the voltage to normal range; c) Seeking technical support; d) Seeking technical support; e) Seeking technical support; f) Seeking technical support;
10#	Frequency converter overload	a) Heavy load or motor blocking; b) Frequency converter selection is small;	a) Reduce load and check motor and mechanical condition; b) Choose a more powerful frequency converter;

No.	Trouble	Troubleshooting	Solution
11#	Motor overload	a) Motor protection parameters bE.01 are incorrectly set; b) Heavy load or motor blocking; c) Frequency converter selection is small;	a) Set this parameter correctly; b) Reduce load and check motor and mechanical condition; c) Choose a more powerful frequency converter;
12#	Input lack phase	a) Three-phase power supply is abnormal; b) Abnormal drive board; c) The surge protection board is abnormal; d) Abnormal main control board;	a) Check and eliminate the problems in peripheral circuits; b) Seeking technical support; c) Seeking technical support; d) Seeking technical support;
14#	Module over hot	a) The ambient temperature is too high; b) Air duct blockage; c) Fan damage; d) The module thermistor is damaged; e) Inverter module damage;	a) Lower the ambient temperature; b) Clean duct; c) Replace; d) Replace; e) Replace;
17#	Contactor damage	a) Drive board and power supply fault; b) Contactor fault;	a) Replace; b) Replace;
18#	Current detection damage	a) Hall device anomaly b) Abnormal drive board;	a) Replace; b) Replace;
19#	Motor tuning damage	a) Motor parameter is not set according to the nameplate; b) Parameter identification overtime;	a) Set the correct motor parameter according to nameplate; b) Check the down-lead form frequency converter to motor;

No.	Trouble	Troubleshooting	Solution
20#	Encoder damage	a) The encoder model does not match; b) Encoder connection error; c) Encoder damage; d) PG card fault;	a) Set the encoder model according to actual situation; b) Remove circle line fault; c) Replace; d) Replace;
23#	Ground damage	The motor shorted to the ground;	Replace cable or motor;
25#	Input lack phase	a) Abnormal down-lead from frequency converter to motor is abnormal; b) The three-phase frequency converter output is abnormal when the is running; c) Abnormal drive board; d) Abnormal module;	a) Troubleshooting peripheral faults; b) Check the three-phase motor winding and remove fault; c) Seeking technical support; d) Seeking technical support;
37#	Abnormal frequency direction	If the given operation frequency is opposite direction to the motor feedback the fault will be invalid by factory default;	Check the motor parameter setting are correct; Check whether the load heavy; Adjust the setting of bC.02;
38#	Abnormal frequency follow	The following error between frequency and motor feedback frequency is too large;	Check the motor parameter setting are correct; Check whether the load heavy Adjust the setting of bC.03 and bC.04;
40#	Current limiting fault	a) Heavy load or motor blocking; b) Frequency converter selection is small;	a) Reduce load and check motor and mechanical condition; b) Choose a more powerful frequency converter;

No.	Trouble	Troubleshooting	Solution
41#	Loose brake fault	The input of the loose brake feedback signal is incorrect;	Check the brake circuit connection; Check the function selection of the feedback input point of the control loose brake;
42#	Closed brake fault	The input of the closed brake feedback signal is incorrect;	Check the brake circuit connection; Check the function selection of the feedback input point of the control closed brake;
43#	Shaft-cooled motor runs overtime at low speed		Adjust the setting of b0.00 and b0.01; Pay attention to protect the motor from overheating;
44#	The forward and reverse operation instruction are valid simultaneously	The frequency converter detected forward and reverse operation instructions	Check the peripheral circuits at the forward and reverse operation command input points; Appropriately improve the terminal filtering time;
45#	Control rod is not zero	When the frequency converter is power on, a given frequency signal is detected;	Ensure that the signal from the standby normally on input point is valid during power-on; Wait until the system initialization is complete before entering commands.

7 SPARE PARTS

7.1 Foreword

Dear Users:

If you need maintenance or fittings for your equipment, please check the order number and the designations of the parts you need in the spare parts manual at first, and inform the local after-sales department of ZOOMLION.

7.2 Configuration of the tower crane

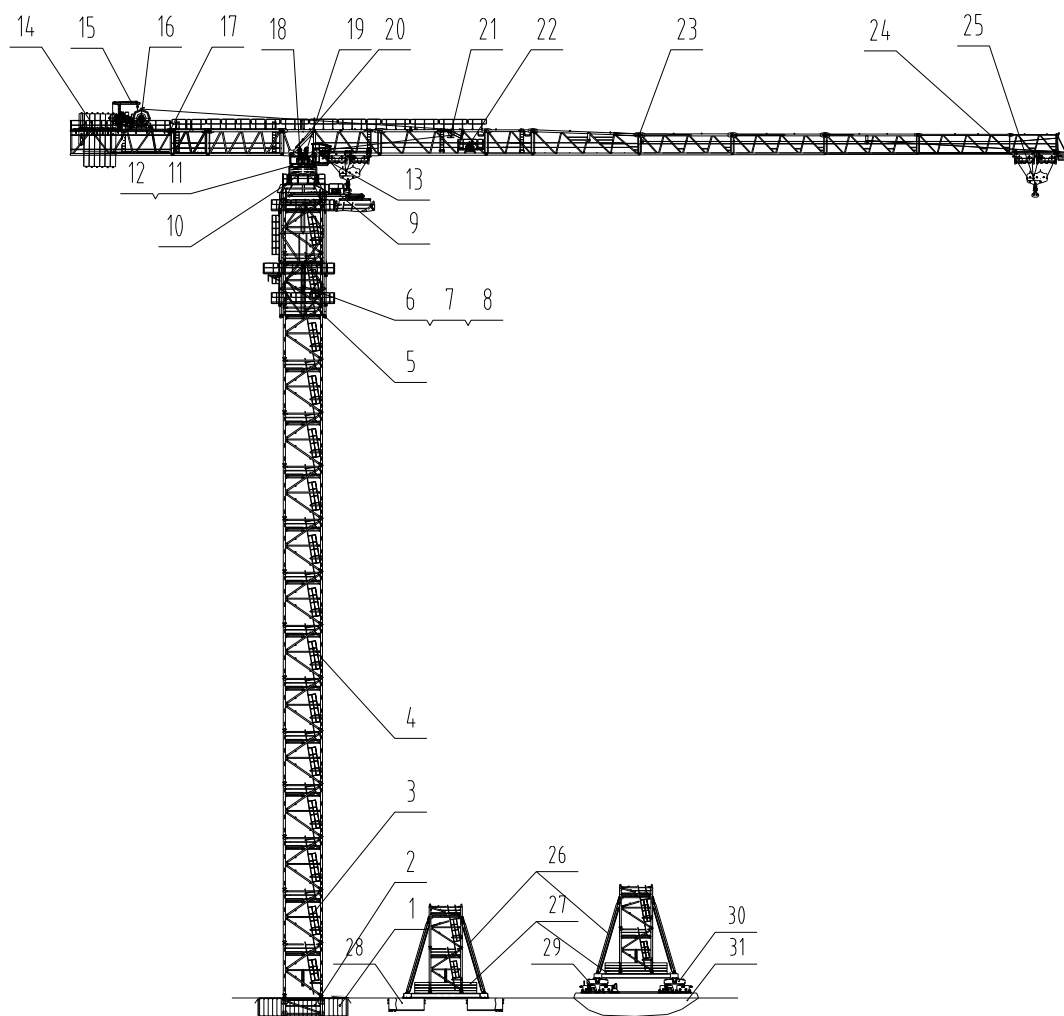


Fig. 7-1 Parts indications of the **T1200-64Q** Tower Crane

Table 7-1 Spare parts list of the T1200-64Q Tower Crane

No.	Designation	Order No.	Code	Notes	Qty
1	Outrigger stationary foundation	000274099AT030000	R1300-64Q-ZGJ		1
2	Outrigger	000201115A1000000	D1100.15A		1
3	Base tower section	000209016A0600000	X42Rb		1
4	Tower section	000209016A0500000	X42D		14/ 12
5	Climbing equipment	000283011AR000000	R1660-80Q.11		1
6	Climbing mechanism	000283012AR000000	R1660-80Q.12		1
7	Climbing hydraulic cylinder	000209503A1800000	YG280/200-2250/2850-31.5B		1
8	Pump station	000209501A1040000	BZ30-33.5		1
9	Mounting device	000274019AT000000	R1300-64Q.19		1
10	Bottom support	000274010CT000000	R1300-64Q.10A		1
11	Slewing ring	1031500332	132.45.2500.1.00.4 2.Z2FK1		1
12	Turntable	000274009AT000000	R1300-64.09		1
13	Cabin	1130000843	CM7		1
14	Counter ballast	000274099BT010000	R1300-64-PHZA		1
15	Derrick	000209914A8400000		Electric	1
16	Hoisting mechanism	000209195A1550000	H200FL160-1150D		1
	Safety brake caliper	000214024AT000000	R1600-64W.24		1
17	Counter jib	000274001AT000000	R1300-64.01		1
18	Slewing mechanism	000209289A1050000	S185CA-350.275CD20/13B		2
19	Slewing mechanism	000209289A1090000	S185CN-350.275CD20/13B		1
20	Moment limiter	1020521047	LJ-D2-K		1
21	Load limiter	1021500776	TWL-5A-R1300-64		1
22	Trolley mechanism	000209370A1900000	T185FC80		1
23	Jib	000274005AT000000	R1300-64.05		1
24	Trolley	000209722A0400000	XC64D		1
25	Hook	000209620A0400000	DG64D		1
26	Chassis	000201114AH000000	D1100.14B		1
27	Central ballast	000201199A0020000	D1100-YZ		1
28	Stationary chassis foundation	000201199A0500000	D1100-63-DGJ		1
29	Travelling bogie I	000209410B0100000	ZA110-B		2
30	Travelling bogie II	000209410B0200000	ZB110-B		2
31	Travelling chassis foundation	000209933A0010000	10mGCA	Gauge 10m	1

7.3 Jib

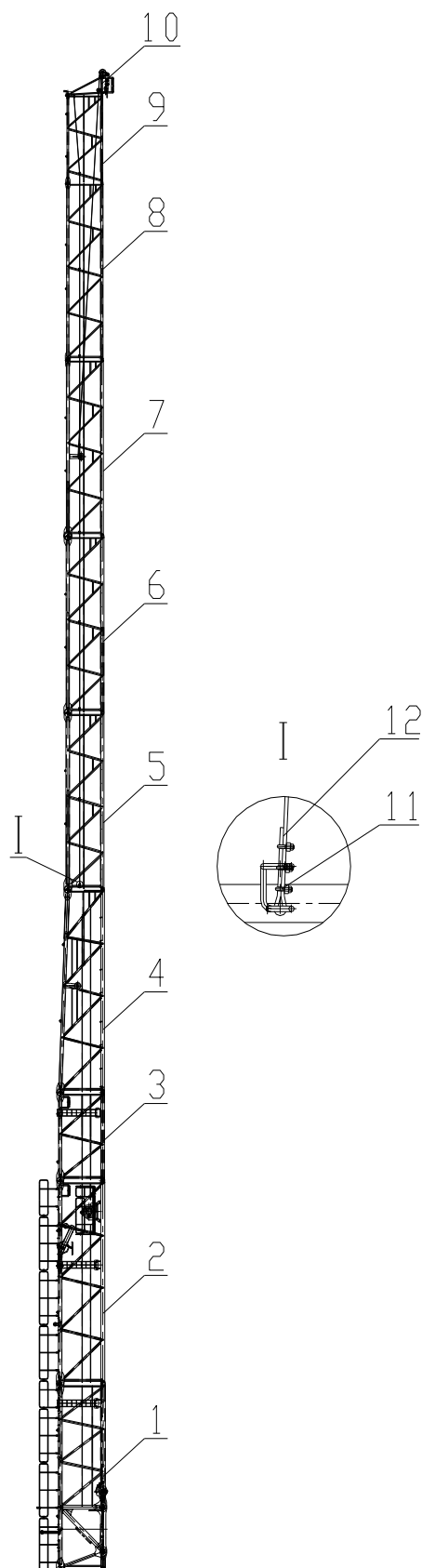
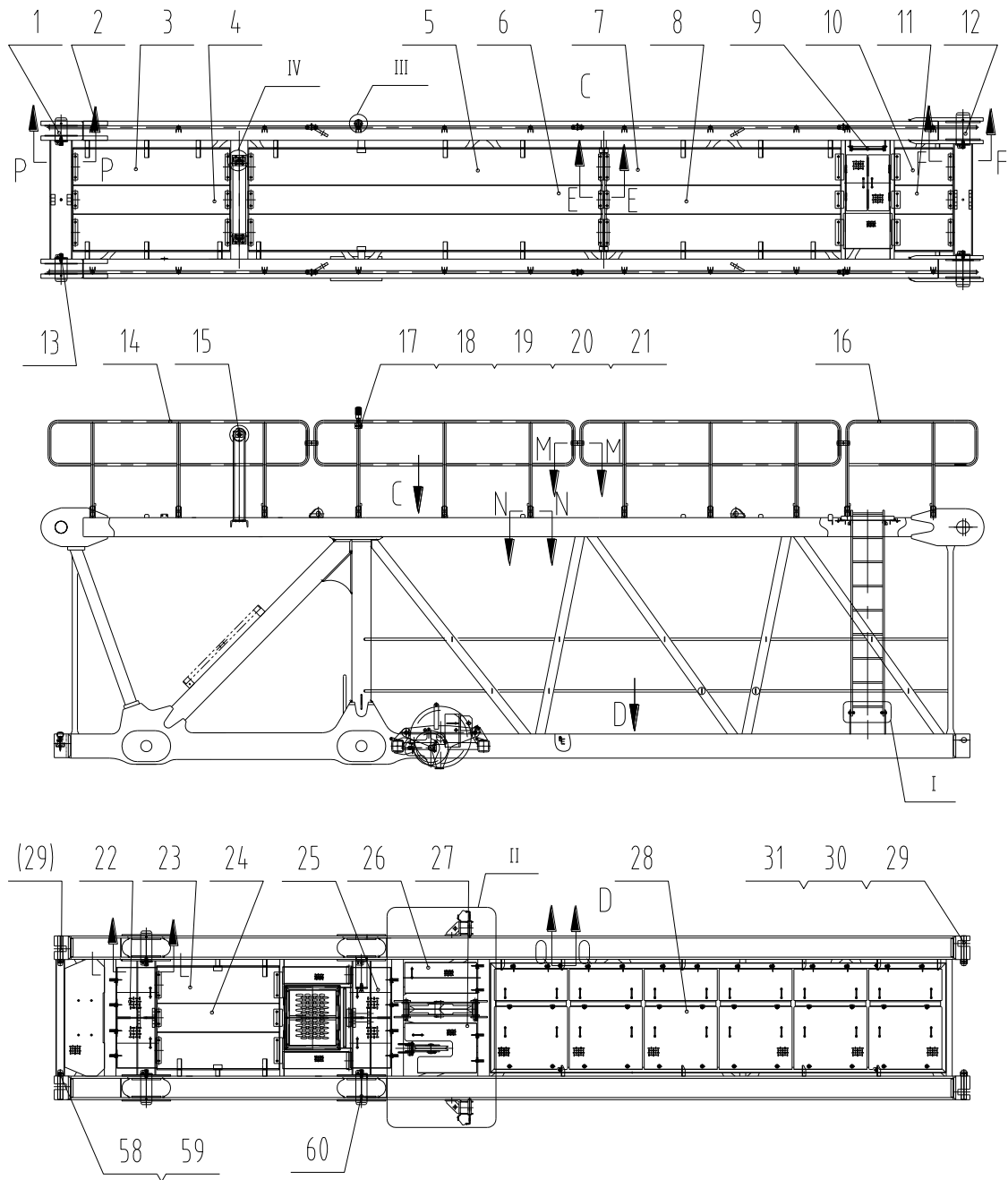


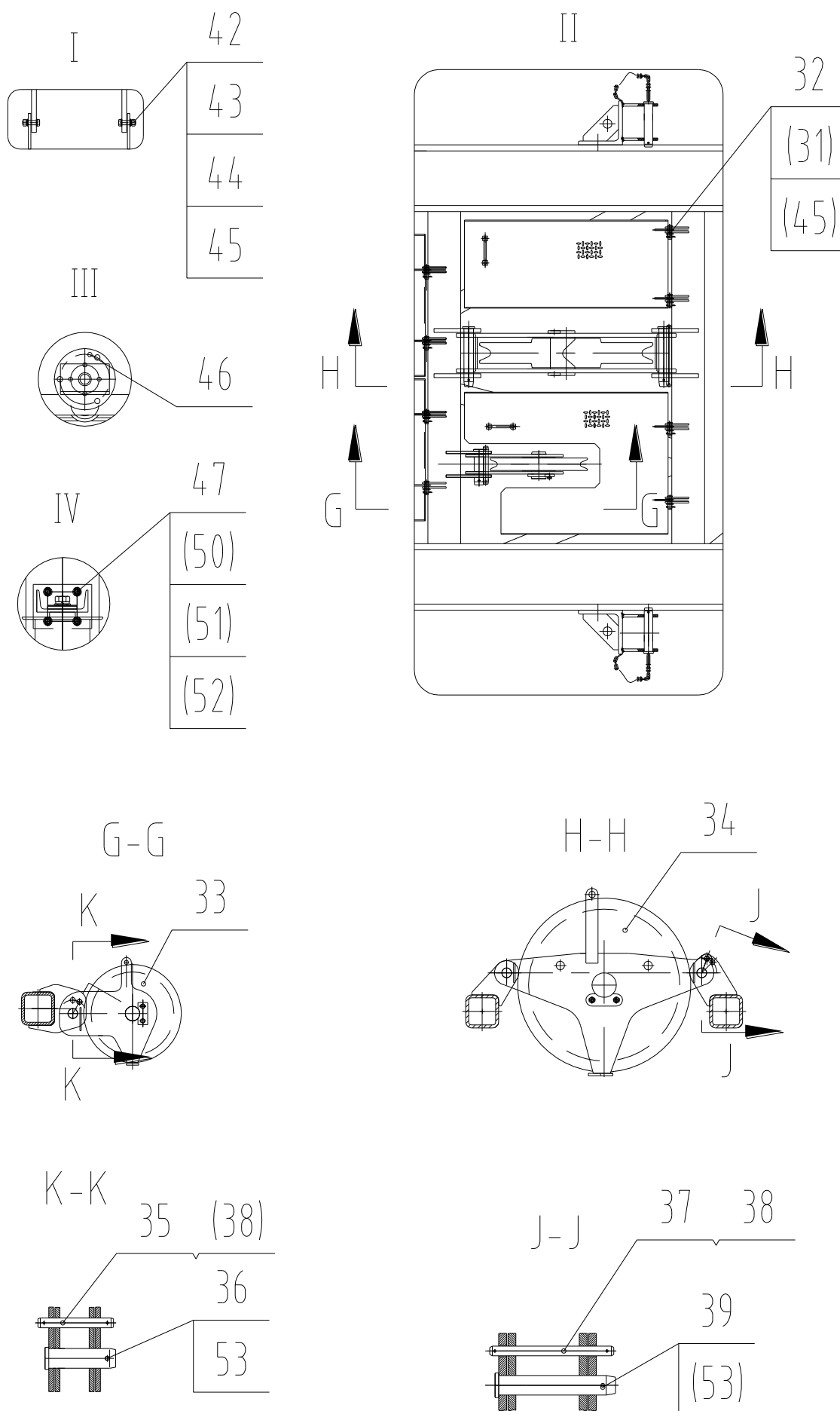
Fig. 7-2 000274005AT000000

Table 7-2 Spare parts list of Jib (R1300-64.05)

No.	Order No.	Code	Designation	Specification	Qty
1	000274005AT001000		Jib I		1
2	000274005AT002000		Jib II		1
3	000274005AT003000		Jib III		1
4	000283005AR004000		Jib IV		1
5	000283005AR005000		Jib V		1
6	000274005AT006000		Jib VI		1
7	000274005AT007000		Jib VII		1
8	000283005AR008000		Jib VIII		1
9	000283005AR009000		Jib IX		1
10	000274005AT010000		Jib end		1
11	1090100213	GB/T5976-1986	Rope clip	12	6
12	1090100470	GB/T8918-2006	Rope	6×29Fi+IWR-11-1770	1

7.3.1 Jib I





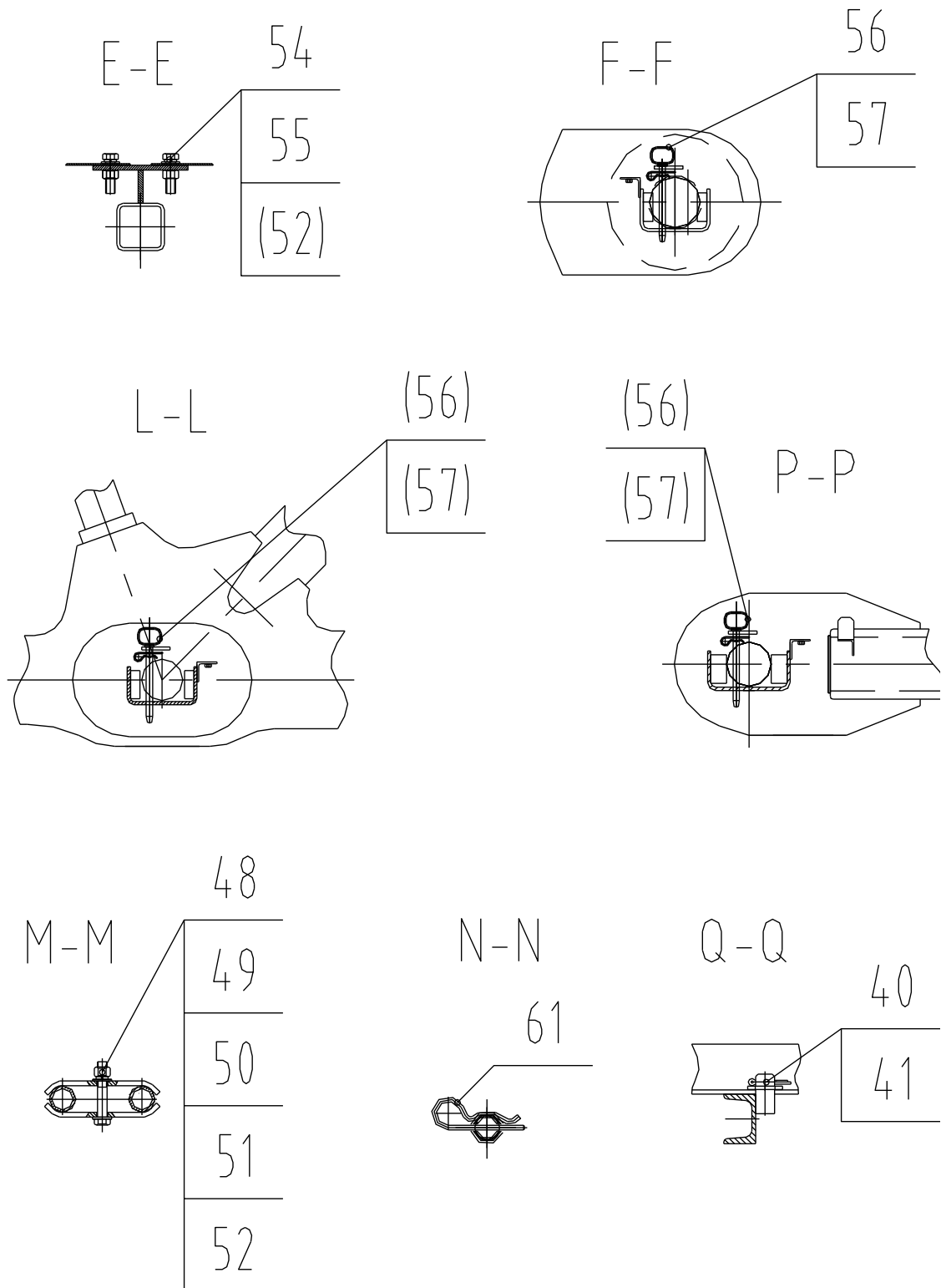


Fig. 7-3 000274005AT001000

Parts No.15, No.28, No.33 and No.34 are exploded in following drawings

Table 7-3 Spare parts list of Jib I

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR001022		Pin	140×235	2
2	000274005AT001100		Jib I structure		1
3	000274005AT001001		Passage	t2	2
4	000274005AT001002		Passage	t2	1
5	000274005AT001003		Passage	t2	2
6	000274005AT001004		Passage	t2	1
7	000274005AT001005		Passage	t2	2
8	000274005AT001006		Passage	t2	1
9	000292005AT001040		Ladder		1
10	000274005AT001007		Passage	t2	2
11	000274005AT001008		Passage	t2	1
12	000283005AR001021		Pin	160×335	2
13	1040003061	GB/T5783-2000	Bolt	M30×50-8.8	8
14	000209913C0030000	LGB3000B	Railing		6
15	000283005AR001070		Roller		1
16	000209913C0015000	LGC1500B	Railing		2
17	000209915A0001000	ZADZ	Obstacle Light Seat		1
18	1040000696	JB/ZQ4321-1997	U-Bolt	33-Zn	2
19	1040200113	GB/T6170-2000	Nut	M10-8	4
20	1040300061	GB/T97.1-2002	Washer	10-200HV	4
21	1040300067	GB/T93-1987	Washer	10	4
22	000274005AT001040		Window		2
23	000274005AT001009		Passage		2
24	000274005AT001010		Passage		1
25	000274005AT001050		Window		2
26	000283005AR001250		Window		1
27	000274005AT001060		Window		1
28	000283005AR001800		Passage		1
29	000283005AR002012		Pin	60×299/345	4
30	000270405BT007002		Pin	Φ16×90/105	2
31	1040500097	GB/T91-2000	Split pin	4×30	14
32	000209910A0160401	XZ01B-16×40/55	Pin	16×40	12
33	000283005AR001400		Trolley pulley		1
34	000274005AT001070		Hoisting pulley		1
35	000209910A3041301	XZ03B-20×130/150	Pin	20×130	1
36	000209910A1081201	XZ01C-40×120/145	Pin	40×120	1
37	000209910A3042301	XZ03B-20×230/250	Pin	20×230	1
38	1040500253	GB/T91-2000	Split pin	5×32	4
39	000209910A1082101	XZ01C-40×210/235	Pin	40×210	2
40	1040500216	GB/T91-2000	Split pin	6.3×50	4

No.	Order No.	Code	Designation	Specification	Qty
41	1040300234	GB/T97.1-2002	Washer	24-200HV	4
42	1040000095	GB/T5783-2000	Bolt	M16×60-8.8	2
43	1040200110	GB/T6170-2000	Nut	M16-8	2
44	1040300065	GB/T93-1987	Washer	16	2
45	1040300052	GB/T97.1-2002	Washer	16-200HV	16
46	000231605ATQ01010		Anemometer seat		1
47	1040000169	GB/T5783-2000	Bolt	M12×45-8.8	8
48	000209913A6000000	LGJB2	Railing splint	T2	12
49	1040000216	GB/T5783-2000	Bolt	M12×70-8.8	6
50	1040200096	GB/T6170-2000	Nut	M12-8	14
51	1040300041	GB/T97.1-2002	Washer	12-200HV	28
52	1040300054	GB/T93-1987	Washer	12	74
53	1040500381	GB/T91-2000	Split pin	8×71	3
54	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	60
55	1040300651	GB/T96-1985	Washer	12-140HV	60
56	000283005AR001365		Safety pin		8
57	000201213A0000003		Spring pin		8
58	000283005AR001360		Safety pin		2
59	000209938A0000060	TX-4-16/20	Spring pin		2
60	000274005AT001011		Pin		4
61	000208899A0002076	TX-6-24/35	Spring pin	Φ6×117	22

7.3.1.1 Rope Roller

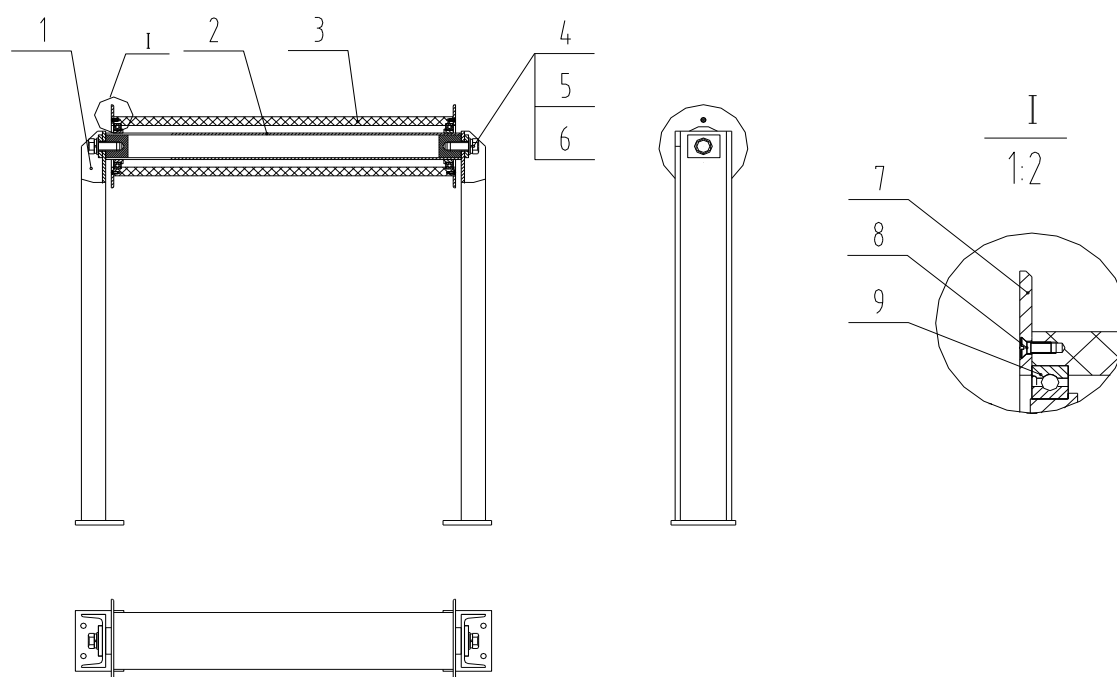


Fig. 7-4 000283005AR001070

Table 7-4 Spare parts list of Rope Roller

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR001080		Support		2
2	000283005AR001090		Installing pin		1
3	000283005AR001071		Roller		1
4	1040000626	GB/T5783-2000	Bolt	M24×55-8.8	2
5	1040300234	GB/T97.1—2002	Washer	24-200HV	2
6	1040300049	GB/T93-1987	Washer	24	2
7	000251005BT001602		Shaft-end baffle		2
8	1040101312	GB/T70.1-2008	Screw	M6×15-4.8	12
9	1050201279	GB/T276-1994	Bearing	61917-2RS	2

7.3.1.2 Platform

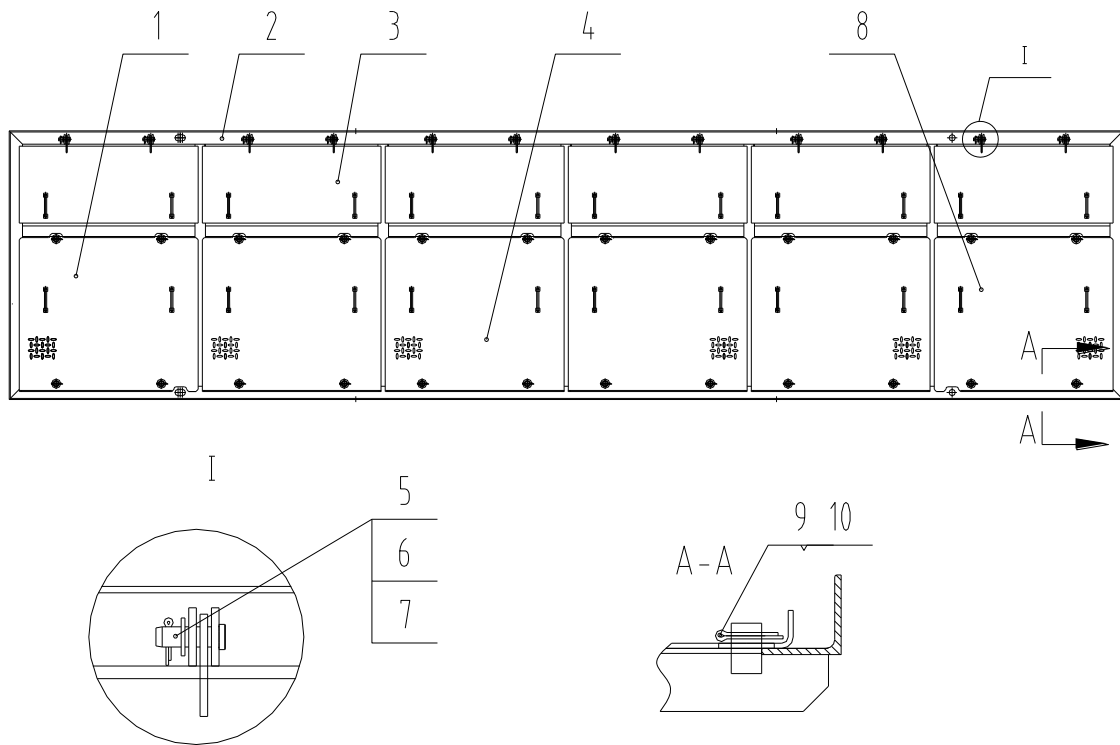


Fig. 7-5 000283005AR001800

Table 7-5 Spare parts list of Platform

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR001820		Window		1
2	000283005AR001810		Platform structure		1
3	000292005AT001510		Turnover door		6
4	000283005AR001830		Window		4
5	000209910A0160401	XZ01B-16×40/55	Pin	16×40	12
6	1040500097	GB/T91-2000	Split pin	4×30	12
7	1040300052	GB/T97.1-2002	Washer	16-200HV	12
8	000283005AR001820		Window		1
9	1040500216	GB/T91-2000	Split pin	6.3×50	24
10	1040300234	GB/T97.1—2002	Washer	24-200HV	24

7.3.1.3 Hoisting Pulley

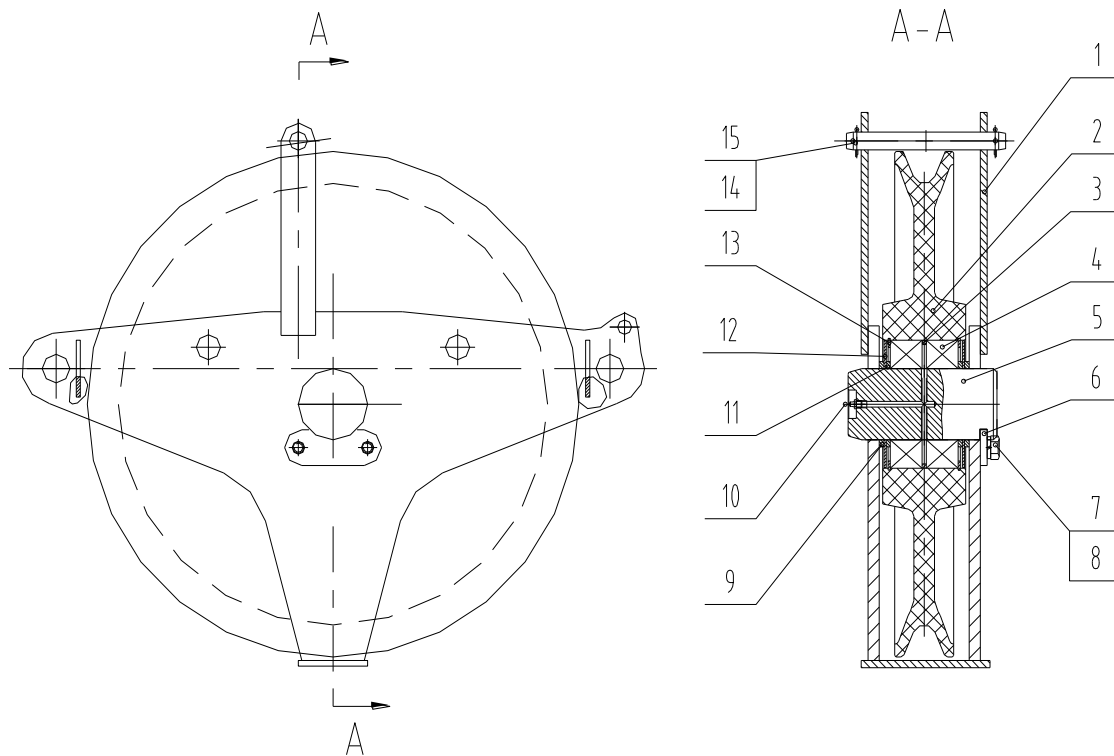


Fig. 7-6 000274005AT001070

Table 7-6 Spare parts list of Hoisting Pulley

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR001710		Pulley support		1
2	000209716A0010010		Pulley		1
3	000209711B0000116		Spacer sleeve		1
4	1050200326	GB/T288-1994	Self-aligning roller bearing	22220C	2
5	000292005AT001701		Pulley shaft		1
6	000251005AT002002		Shaft-end baffle	t10	1
7	1040000016	GB/T5783-2000	Bolt	M16×35-8.8	2
8	1040300065	GB/T93-1987	Spring washer	16	2
9	000221103A0000020		Spacer sleeve		2
10	1080000007	JB/T7940.1-1995	Oil Cup	M10×1	2
11	000209711B0000117		Shaft sleeve		2
12	000209711B0000118		Metal seal ring		2
13	1040300644	GB/T893.2-1986	Retainer ring	180	2
14	000200111T0000002	XZ03A-25×200/230	Pin	25×200	1
15	1040500253	GB/T91-2000	Split pin	5×32	2

7.3.1.4 Trolley Pulley

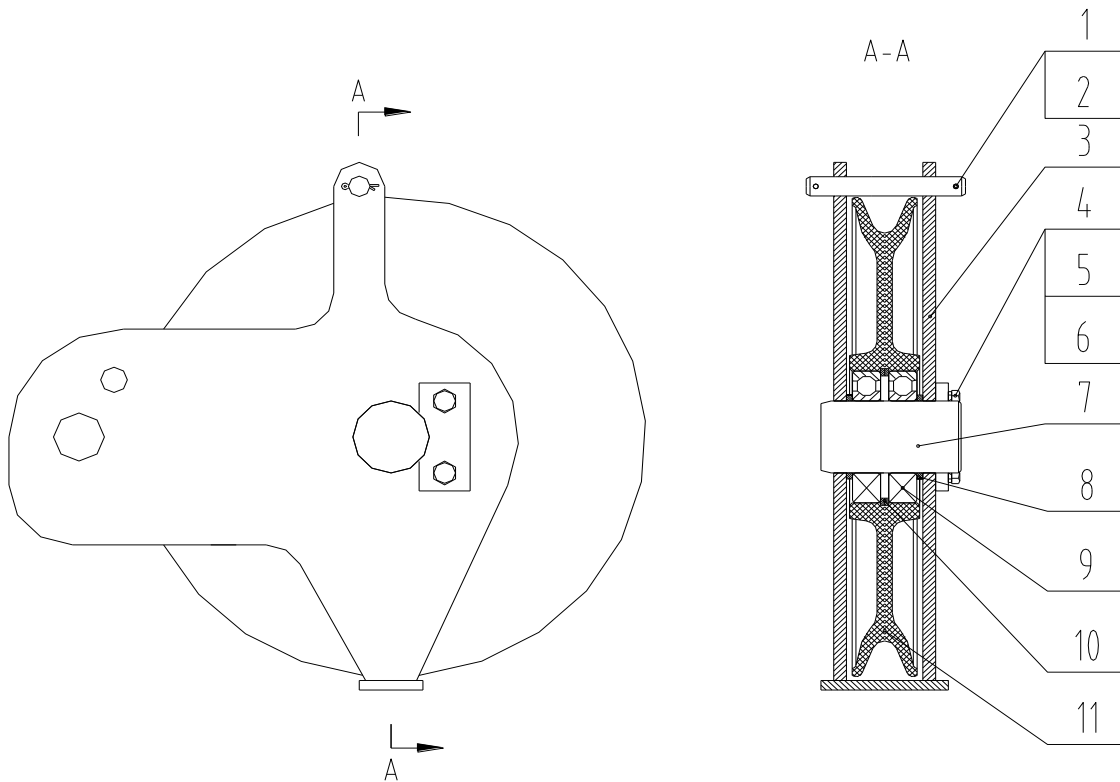
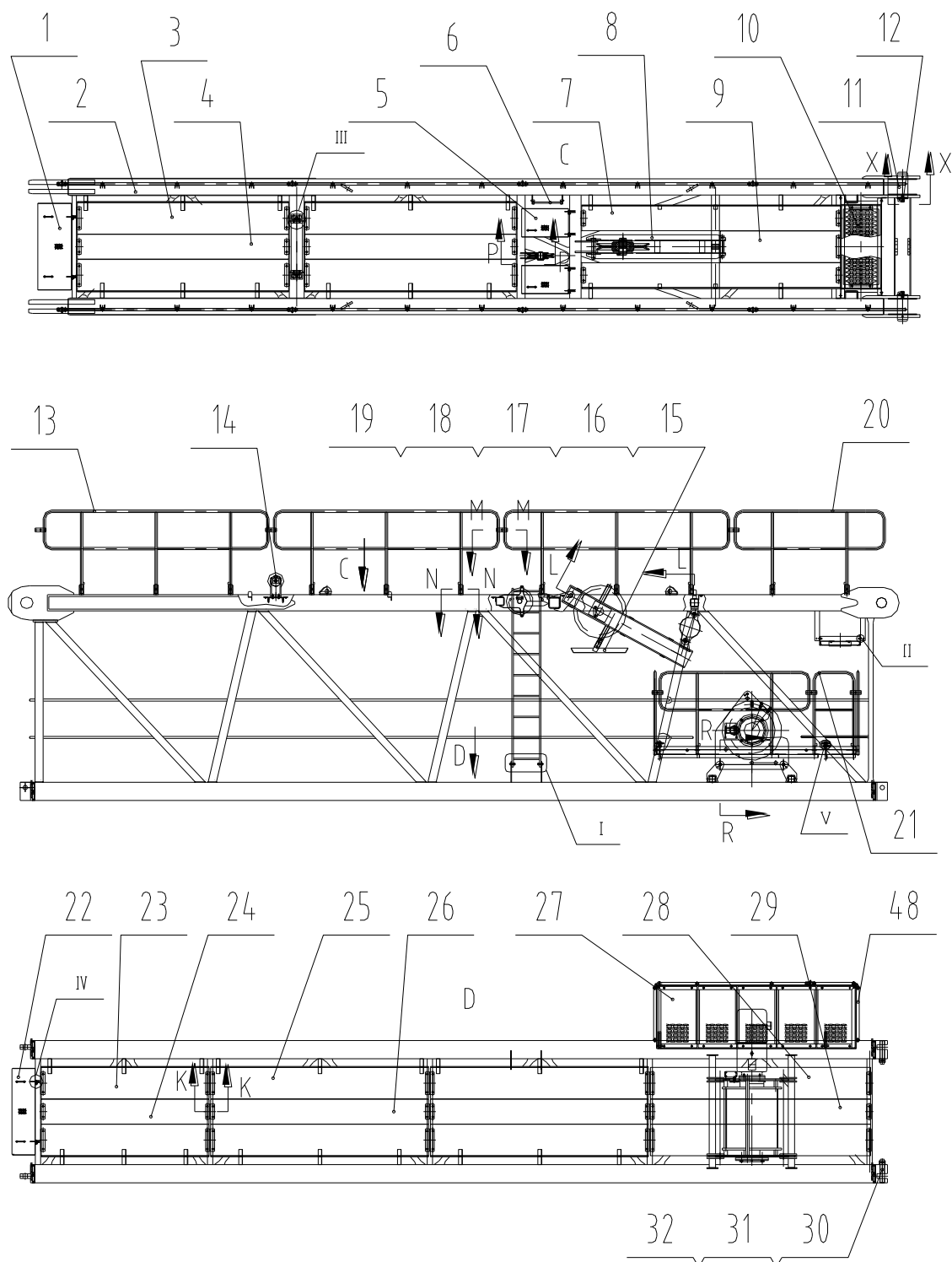


Fig. 7-7 00028305AR001400

Table 7-7 Spare parts list of Trolley Pulley

No.	Order No.	Code	Designation	Specification	Qty
1	000209910A0161101	XZ03B-16×110/125	Pin	16×110	1
2	1040500097	GB/T91-2000	Split pin	4×30	2
3	000283005AR001410		Pulley support		1
4	000283005AR004011		Pallet	t10	1
5	1040000114	GB/T5783-2000	Bolt	M10×25-8.8	2
6	1040300067	GB/T93-1987	Spring washer	10	2
7	000270405DT001002		Pulley shaft	Φ60×82/110	1
8	000209605A0000020	FDG08A.01-7	Shaft sleeve		2
9	1050201562	GB/T276-2004	Deep groove ball bearing	6212-2RS1	2
10	1040300283	GB/T893.2-1986	Check Ring	110	2
11	000209906A0013000	400-340-B55-110-R8.5	Pulley		1

7.3.2 Jib II



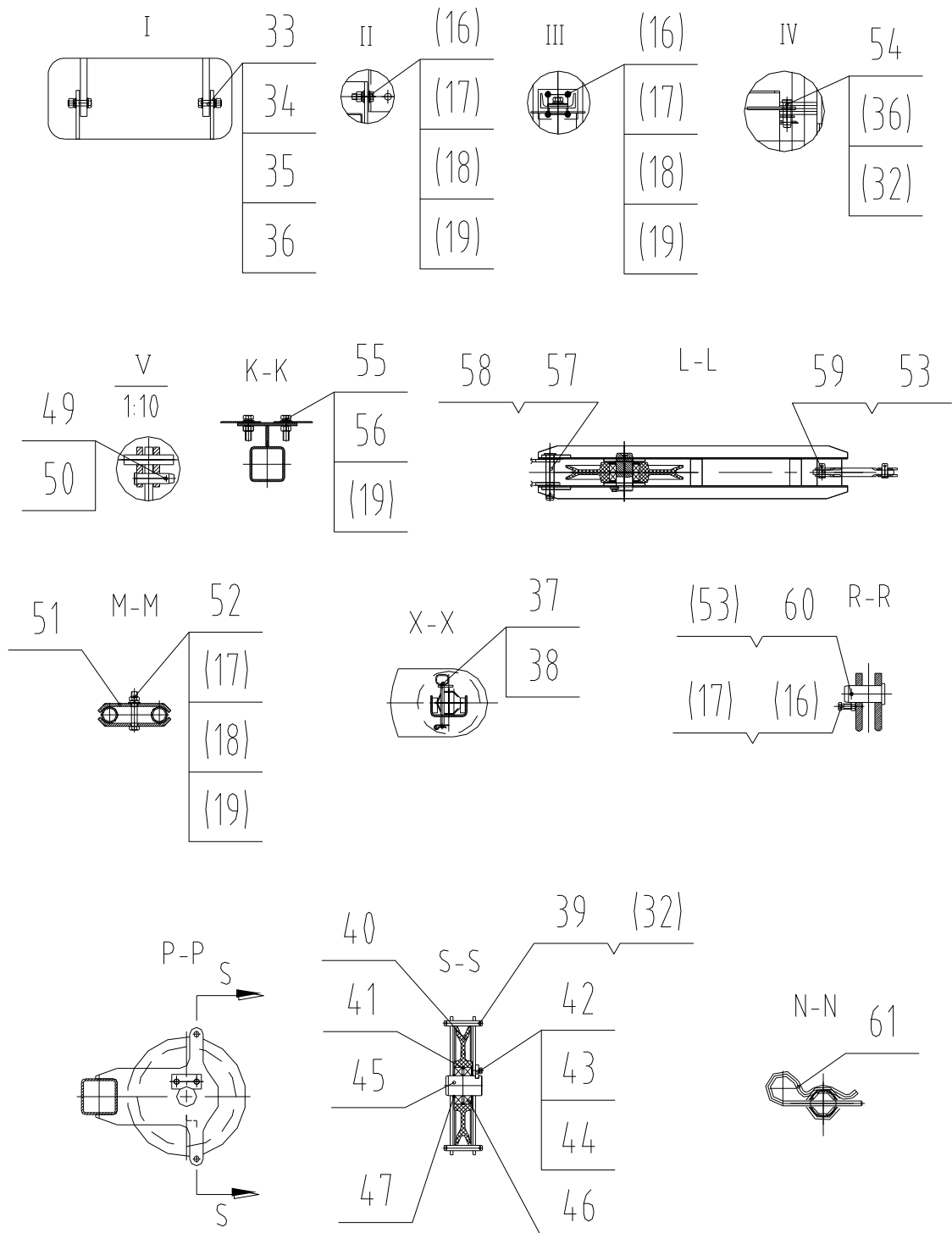


Fig. 7-8 000274005AT002000

Parts No.8, No.10, No.14 and No.27 are exploded in following drawings

Table 7-8 Spare parts list of Jib II

No.	Order No.	Code	Designation	Specification	Qty
1	000274005AT002040		Platform		1
2	000274005AT002100		Jib II structure		1
3	000274005AT002001		Passage	t2	4
4	000274005AT002002		Passage	t2	2
5	000283005AR002090		Platform		2
6	000292005AT001040		Ladder		1
7	000283005AR002004		Passage	t2	2
8	000274005AT002020		Load limiter		1
9	000283005AR002006		Passage	t2	1
10	000274005AT002010		Platform		1
11	000283005AR002031		Pin	140×315	2
12	1040003061	GB/T5783-2000	Bolt	M30×50-8.8	2
13	000209913C0030000	LGB3000B	Railing		6
14	000292005AT002300		Roller		1
15	000274005AT002050		Oil tray		1
16	1040000169	GB/T5783-2000	Bolt	M12×45-8.8	20
17	1040200096	GB/T6170-2000	Nut	M12-8	31
18	1040300041	GB/T97.1-2002	Spring washer	12-200HV	52
19	1040300054	GB/T93-1987	Spring washer	12	111
20	000209913C0020000	LGB2000B	Railing		3
21	000209913D0005300	LGA530B	Railing		1
22	000283005AR002095		Platform		1
23	000283005AR002007		Passage	t2	2
24	000283005AR002008		Passage	t2	1
25	000283005AR004005		Passage	t2	4
26	000283005AR004006		Passage	t2	2
27	000283005AR002700		Maintenance platform		1
28	000283005AR002010		Passage	t2	2
29	000283005AR002011		Passage	t2	1
30	000283005AR003006		Pin	60×267/315	2
31	000270405BT007002		Pin	Φ16×90/105	2
32	1040500097	GB/T91-2000	Split pin	4×30	16
33	1040000095	GB/T5783-2000	Bolt	M16×60-8.8	2
34	1040200110	GB/T6170-2000	Nut	M16-8	2

No.	Order No.	Code	Designation	Specification	Qty
35	1040300065	GB/T93-1987	Spring washer	16	2
36	1040300052	GB/T97.1-2002	Spring washer	16-200HV	16
37	000263005AT003035		Safety pin		2
38	000201213A0000003		Spring pin		2
39	000209910A0161001	XZ03B-16×100/115	Pin	16×100	2
40	000209906A0012000	360-300-B55-110-R7.5	Pulley		1
41	1040300283	GB/T893.2-1986	Retainer ring	110	2
42	000283005AR002019		Pallet	t10	1
43	1040300067	GB/T93-1987	Spring washer	10	2
44	1040000114	GB/T5783-2000	Bolt	M10×25-8.8	2
45	000270405DT001002		Pulley shaft	Φ60×82/110	1
46	1050201562	GB/T276-2004	Deep groove ball bearing	6212-2RS1	2
47	000209605A0000020	FDG08A.01-7	Shaft sleeve		2
48	000209913C0007000	LGA700B	Railing		2
49	000209910A1040601	XZ01B-20×60/80	Pin	20×60	2
50	1040500253	GB/T91-2000	Split pin	5×32	2
51	000209913A6000000	LGJB2	Railing splint	t2	22
52	1040000216	GB/T5783-2000	Bolt	M12×70-8.8	11
53	1040500381	GB/T91-2000	Split pin	8×71	6
54	000209910A0160401	XZ01B-16×40/55	Pin	16×40	8
55	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	84
56	1040300651	GB/T96-1985	Spring washer	12-140HV	84
57	000209910A1102301	XZ01C-50×230/260-T	Pin	50×230	1
58	1040500244	GB/T91-2000	Split pin	10×71	1
59	000209910A1070601	XZ01C-35×60/85	Pin	35×60	2
60	000209910A1080801	XZ01C-40×80/105	Pin	40×80	4
61	000208899A0002076	TX-6-24/35	Spring pin	Φ6×117	30

7.3.2.1 Load Limiter

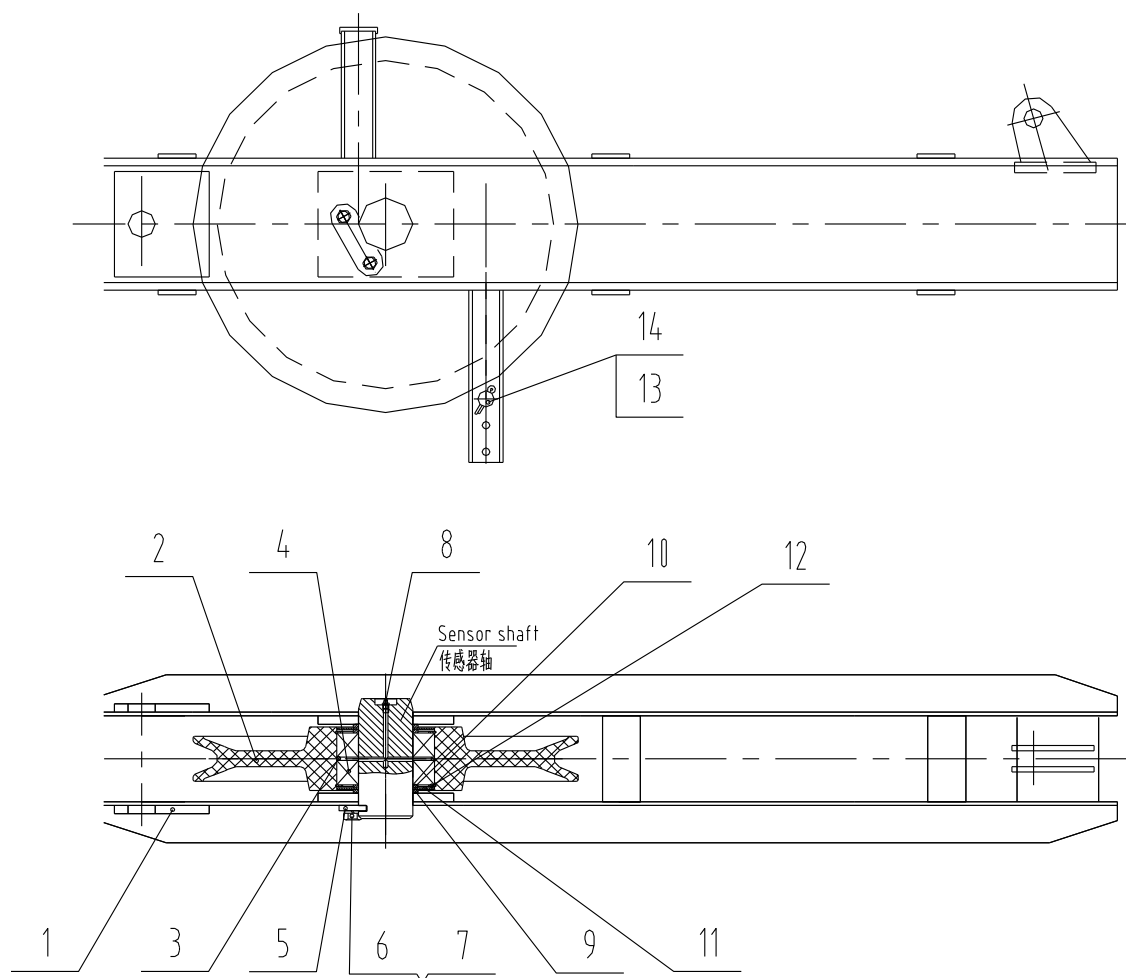


Fig. 7-9 000274005AT002020

Table 7-9 Spare parts list of Load Limiter

No.	Order No.	Code	Designation	Specification	Qty
1	000251005CT002700		Load limiter support		1
2	000209716A0010010		Pulley		1
3	000209711B0000116		Spacer sleeve		1
4	1050200326	GB/T288-1994	Self-aligning roller bearing	22220C	2
5	000251005AT002002		Shaft-end baffle	t10	1
6	1040000016	GB/T5783-2000	Bolt	M16×35-8.8	2
7	1040300065	GB/T93-1987	Spring washer	16	2
8	1080000007	JB/T7940.1-1995	Oil Cup	M10×1	1
9	000221103A0000020		Spacer sleeve		2
10	000209711B0000117		Shaft sleeve		2
11	000209711B0000118		Metal seal ring		2
12	1040300644	GB/T893.2-1986	Retainer ring	180	2
13	000210608AT042021	XZ01C-30×235/265	Pin	30×235	1
14	1040500224	GB/T91-2000	Split pin	6.3×63	1

7.3.2.2 Platform

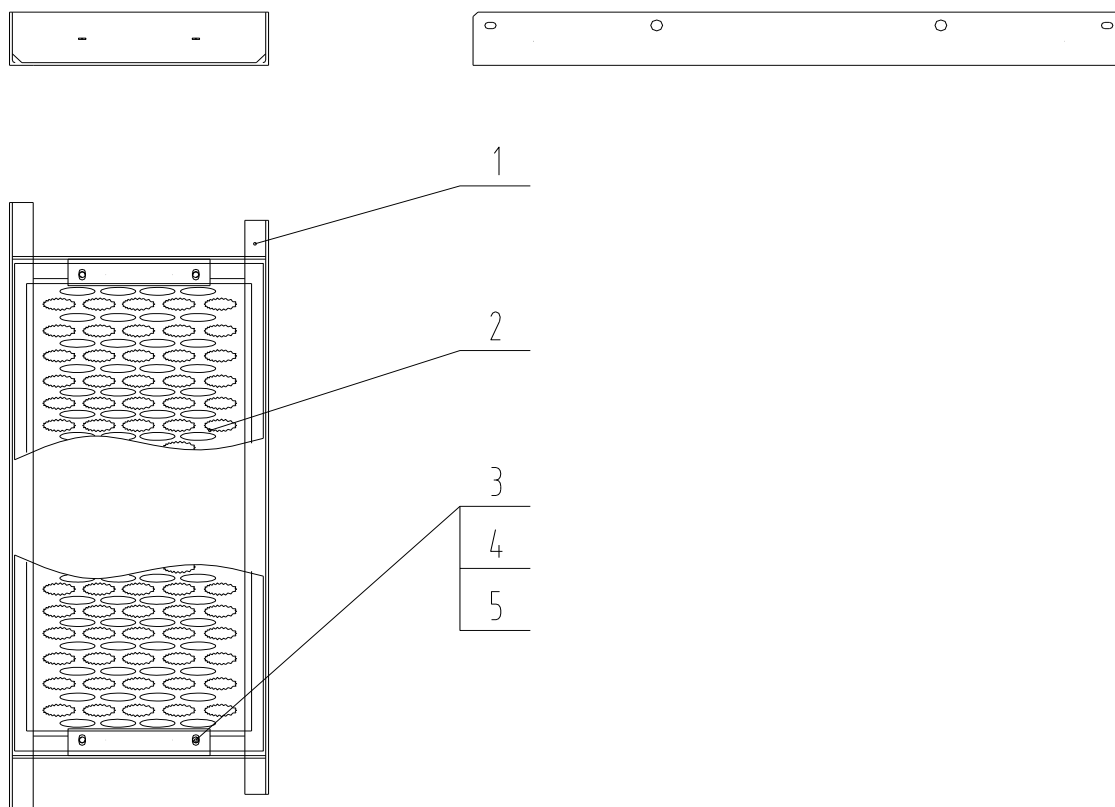


Fig. 7-10 000274005AT002010

Table 7-10 Spare parts list of Platform

No.	Order No.	Code	Designation	Specification	Qty
1	000274005AT002011		Platform structure		1
2	000283005AR003066		Passage	t2	1
3	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	4
4	1040300651	GB/T96-1985	Spring washer	12-140HV	4
5	1040300054	GB/T93-1987	Spring washer	12	4

7.3.2.3 Rope Roller

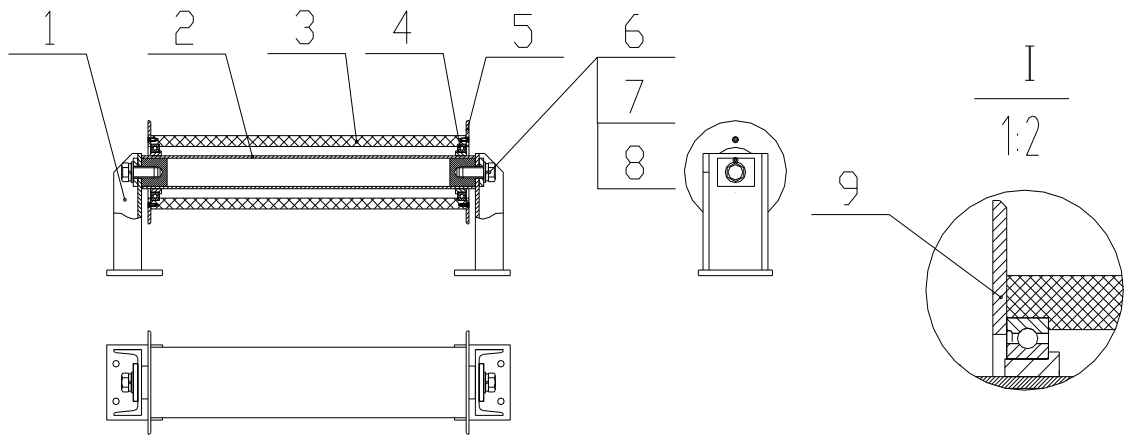


Fig. 7-11 000292005AT002300

Table 7-11 Spare parts list of Rope Roller

No.	Order No.	Code	Designation	Specification	Qty
1	000292005AT002310		Support		2
2	000251005BT001620		Installing pin		1
3	000251005BT001601		Roller		1
4	1050201279	GB/T276-1994	Bearing	61917-2RS	2
5	000251005BT001602		Shaft-end baffle		2
6	1040000626	GB/T5783-2000	Bolt	M24×55-8.8	2
7	1040300234	GB/T97.1—2002	Spring washer	24-200HV	2
8	1040300049	GB/T93-1987	Spring washer	24	2
9	1040101312	GB/T70.1-2008	Screw	M6×15-4.8	12

7.3.2.4 Maintenance Platform

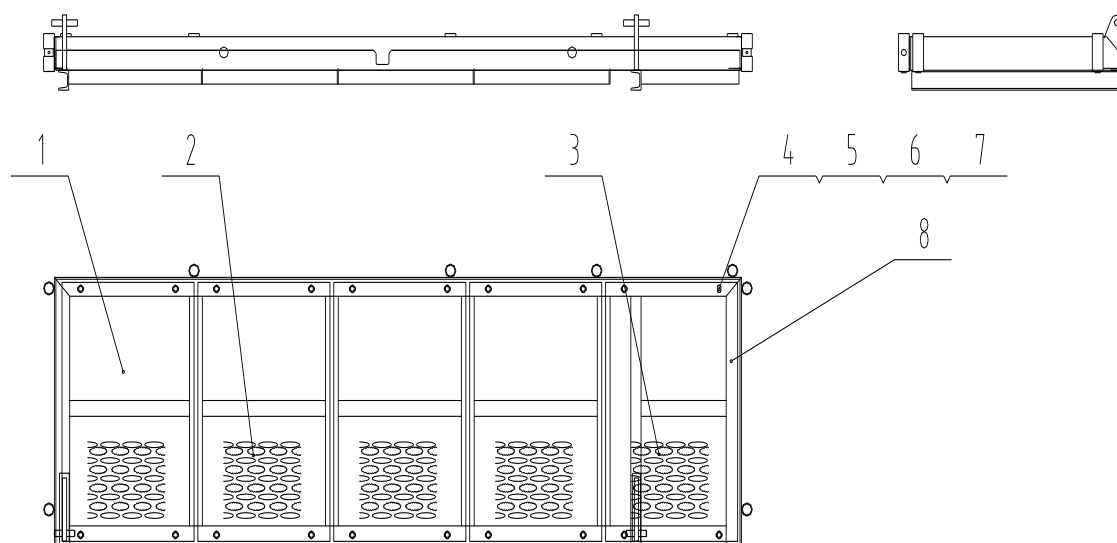
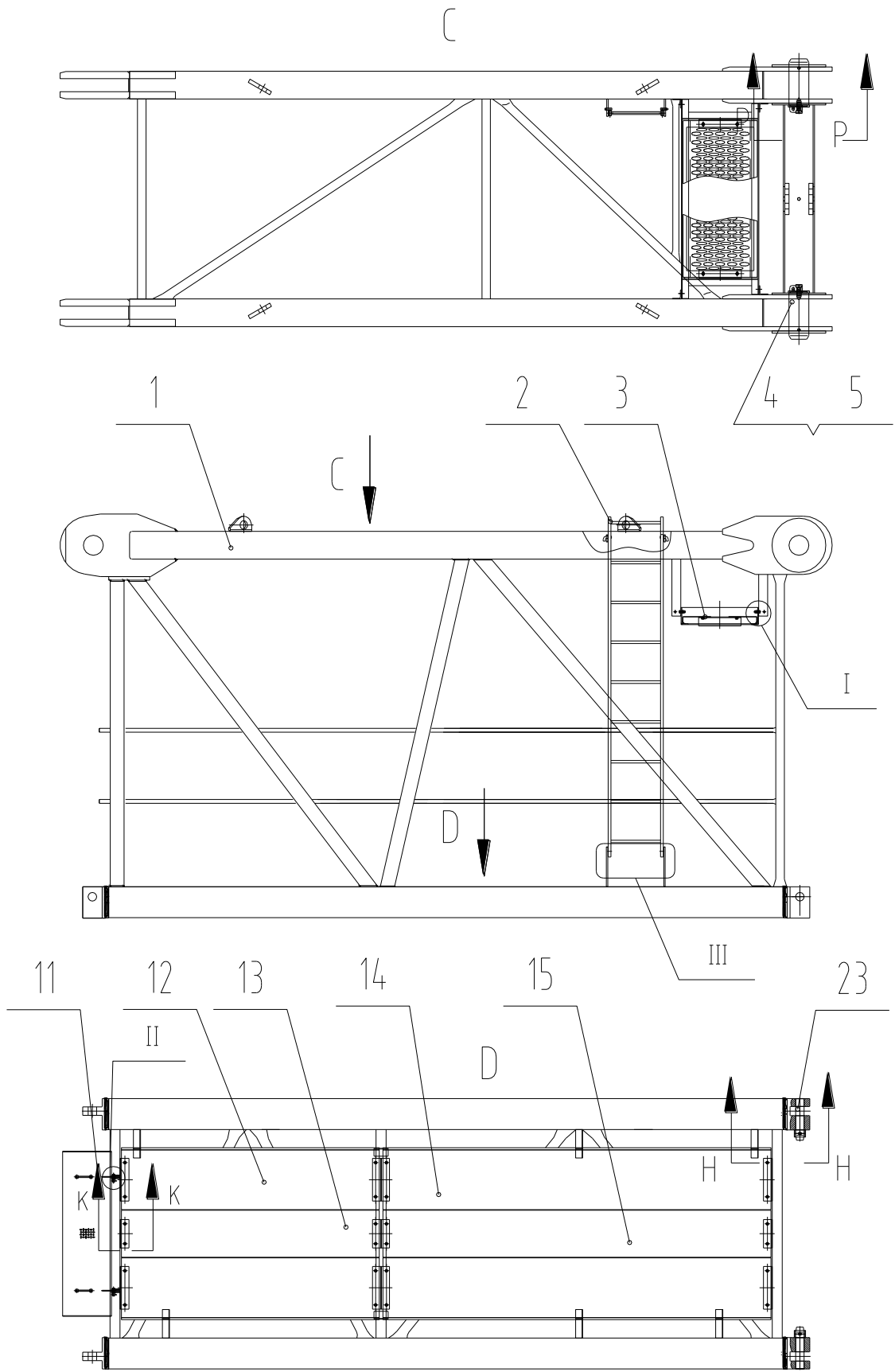


Fig. 7-12 000283005AR002700

Table 7-12 Spare parts list of Maintenance Platform

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR002701		Pattern plate	t2	1
2	000283005AR002702		Pattern plate	t2	3
3	000283005AR002703		Pattern plate	t2	1
4	1040200096	GB/T6170-2000	Nut	M12-8	20
5	1040300054	GB/T93-1987	Spring washer	12	20
6	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	20
7	1040300651	GB/T96-1985	Washer	12-140HV	40
8	000283005AR002710		Platform structure		1

7.3.3 JibIII



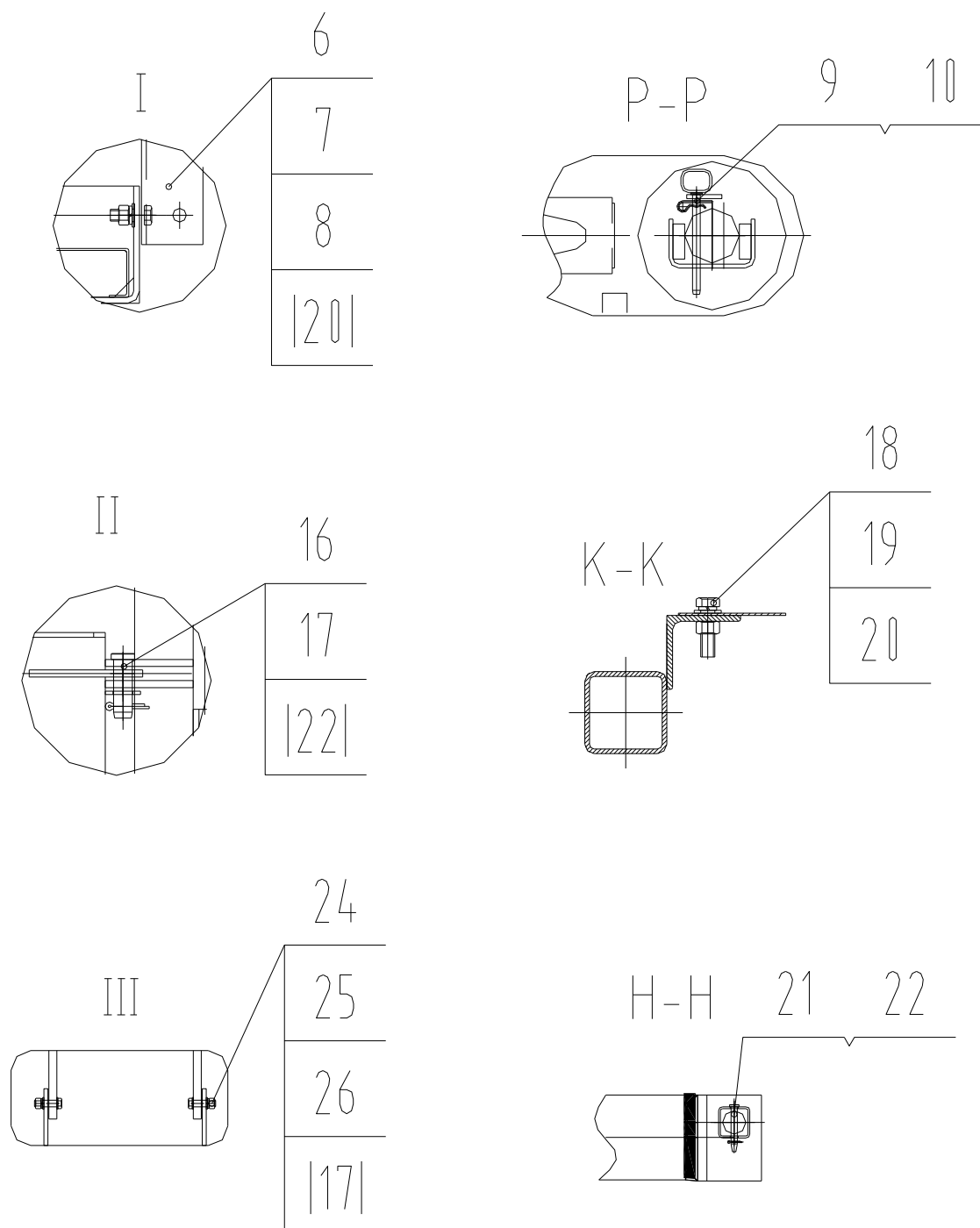


Fig. 7-13 000274005AT003000

Part No.3 is exploded in following drawing

Table 7-13 Spare parts list of JibIII

No.	Order No.	Code	Designation	Specification	Qty
1	000274005AT003100		JibIII structure		1
2	000292005AT001040		Ladder		1
3	000283005AR003060		Platform		1
4	000283005AR003003		Pin	140×300	2
5	1040003061	GB/T5783-2000	Bolt	M30×50-8.8	2
6	1040002440	GB/T5783-2016	Bolt	M12×45-8.8	4
7	1040200096	GB/T6170-2000	Nut	M12-8	4
8	1040300041	GB/T97.1-2002	Spring washer	12-200HV	8
9	000263005AT003035		Safety pin		2
10	000201213A0000003		Spring pin		2
11	000274005AT003010		Platform		1
12	000274005AT003001		Passage	t2	2
13	000274005AT003002		Passage	t2	1
14	000274005AT003003		Passage	t2	2
15	000274005AT003004		Passage	t2	1
16	000209910A0160401	XZ01B-16×40/55	Pin	16×40	2
17	1040300052	GB/T97.1-2002	Spring washer	16-200HV	4
18	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	24
19	1040300651	GB/T96-1985	Spring washer	12-140HV	24
20	1040300054	GB/T93-1987	Spring washer	12	28
21	000270405BT007002		Pin	Φ16×90/105	2
22	1040500097	GB/T91-2000	Split pin	4×30	4
23	000212005AT001001		Pin	60×245/290	2
24	1040000095	GB/T5783-2000	Bolt	M16×60-8.8	2
25	1040200110	GB/T6170-2000	Nut	M16-8	2
26	1040300065	GB/T93-1987	Spring washer	16	2

7.3.3.1 Platform

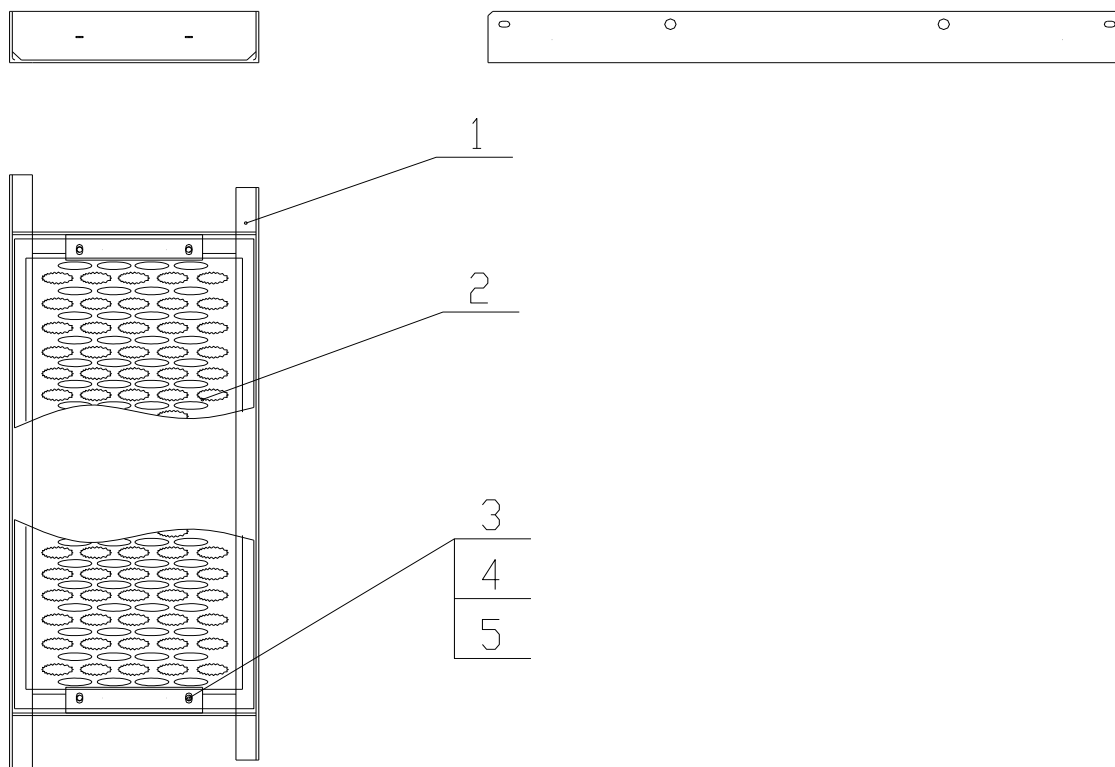
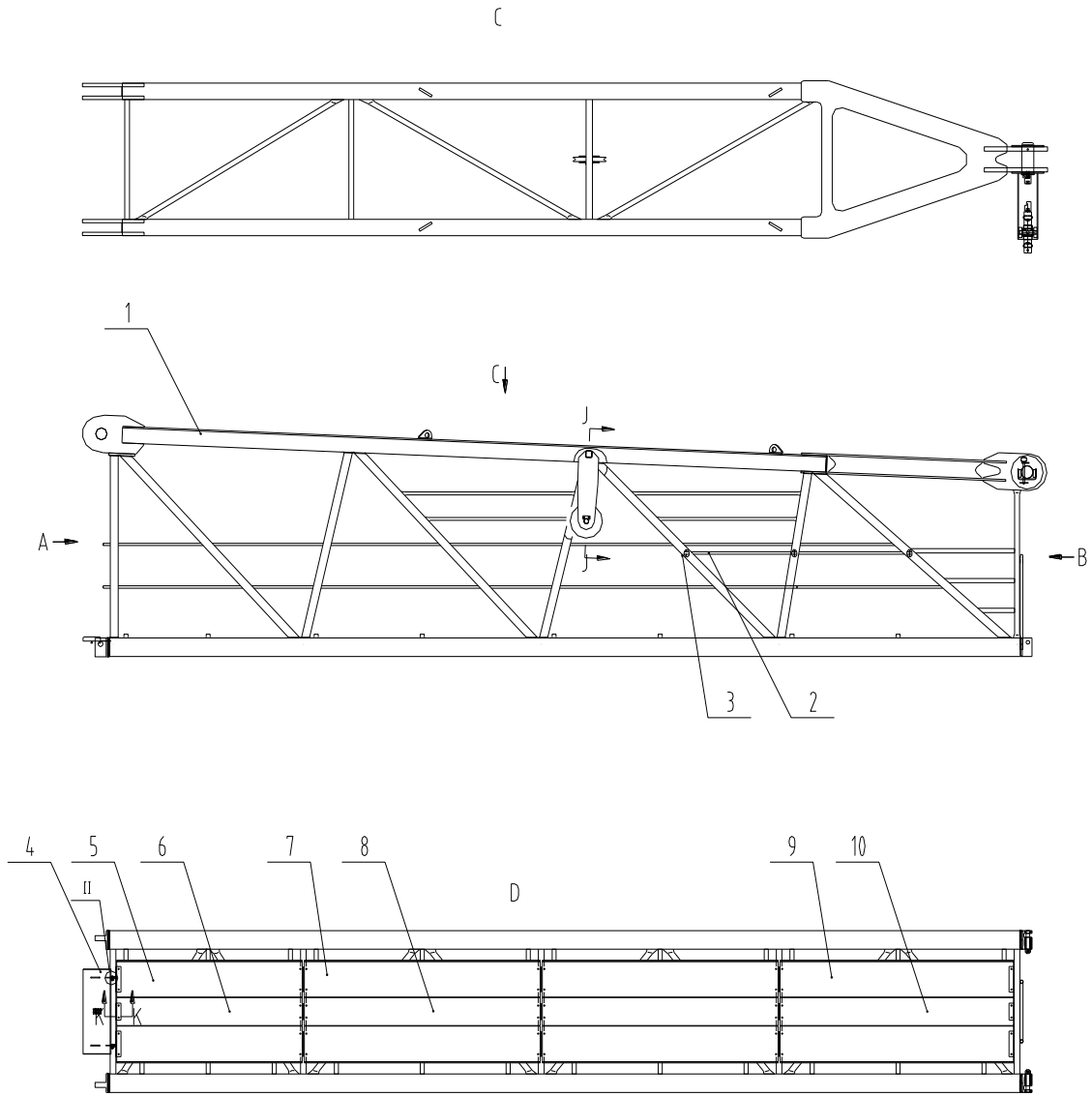


Fig. 7-14 000283005AR003060

Table 7-14 Spare parts list of Platform

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR003061		Platform structure		1
2	000283005AR003066		Passage	t2	1
3	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	4
4	1040300651	GB/T96-1985	Spring washer	12-140HV	4
5	1040300054	GB/T93-1987	Spring washer	12	4

7.3.4 JibIV



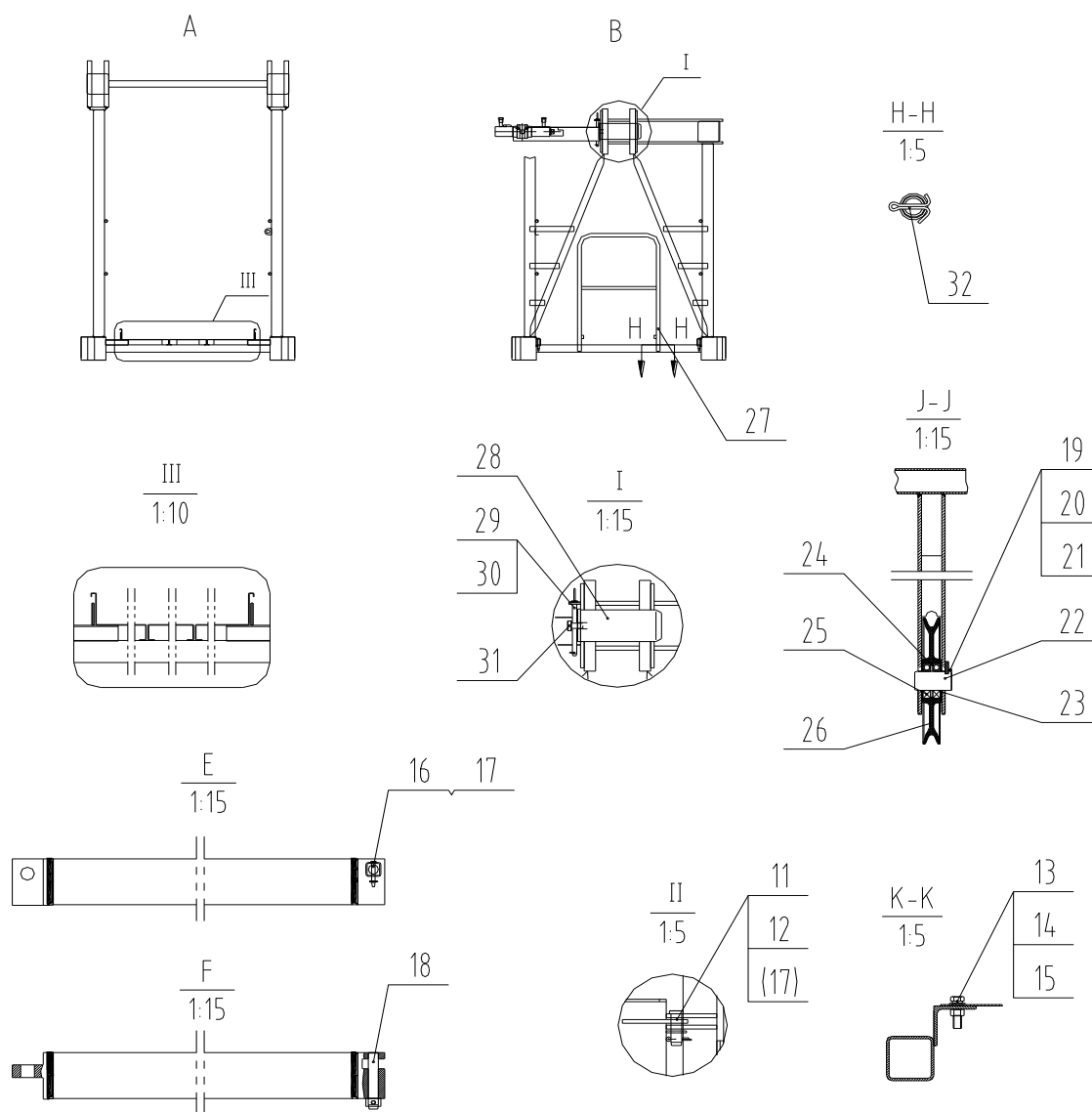


Fig. 7-15 000283005AR004000

Table 7-15 Spare parts list of JibⅣ

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR004100		JibⅣ structure		1
2	000283005AR004001		Cross railing	Φ26.8×2.5	1
3	000209605A0000055	FDG08A.02-3	Inserting pin		2
4	000283005AR004090		Platform		1
5	000283005AR004002		Passage	t2	2
6	000283005AR004003		Passage	t2	1
7	000283005AR004005		Passage	t2	4
8	000283005AR004006		Passage	t2	2
9	000283005AR004008		Passage	t2	2
10	000283005AR004009		Passage	t2	1
11	000209910A0160401	XZ01B-16×40/55	Pin	16×40	2
12	1040300052	GB/T97.1-2002	Spring washer	16-200HV	2
13	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	48
14	1040300651	GB/T96-1985	Spring washer	12-140HV	48
15	1040300054	GB/T93-1987	Spring washer	12	48
16	000270405BT007002		Pin	Φ16×90/105	2
17	1040500097	GB/T91-2000	Split pin	4×30	4
18	000292005AT003001		Pin	45×236/267	2
19	000283005AR004011		Pallet	t10	1
20	1040000114	GB/T5783-2000	Bolt	M10×25-8.8	2
21	1040300067	GB/T93-1987	Spring washer	10	2
22	000270405DT001002		Pulley shaft	Φ60×82/110	1
23	000209605A0000020	FDG08A.01-7	Shaft sleeve		2
24	1040300283	GB/T893.2-1986	Retainer ring	110	2
25	1050201562	GB/T276-2004	Deep groove ball bearing	6212-2RS1	2
26	000209906A0013000	400-340-B55-110-R8.5	Pulley		1
27	000209913C0007000	LGA700B	Railing		1
28	000283005AR004031		Pin	150×335	1
29	000263005AT003035		Safety pin		1
30	000201213A0000003		Spring pin		1
31	1040003061	GB/T5783-2000	Bolt	M30×50-8.8	1
32	1040500381	GB/T91-2000	Split pin	8×71	2

7.3.5 Jib V

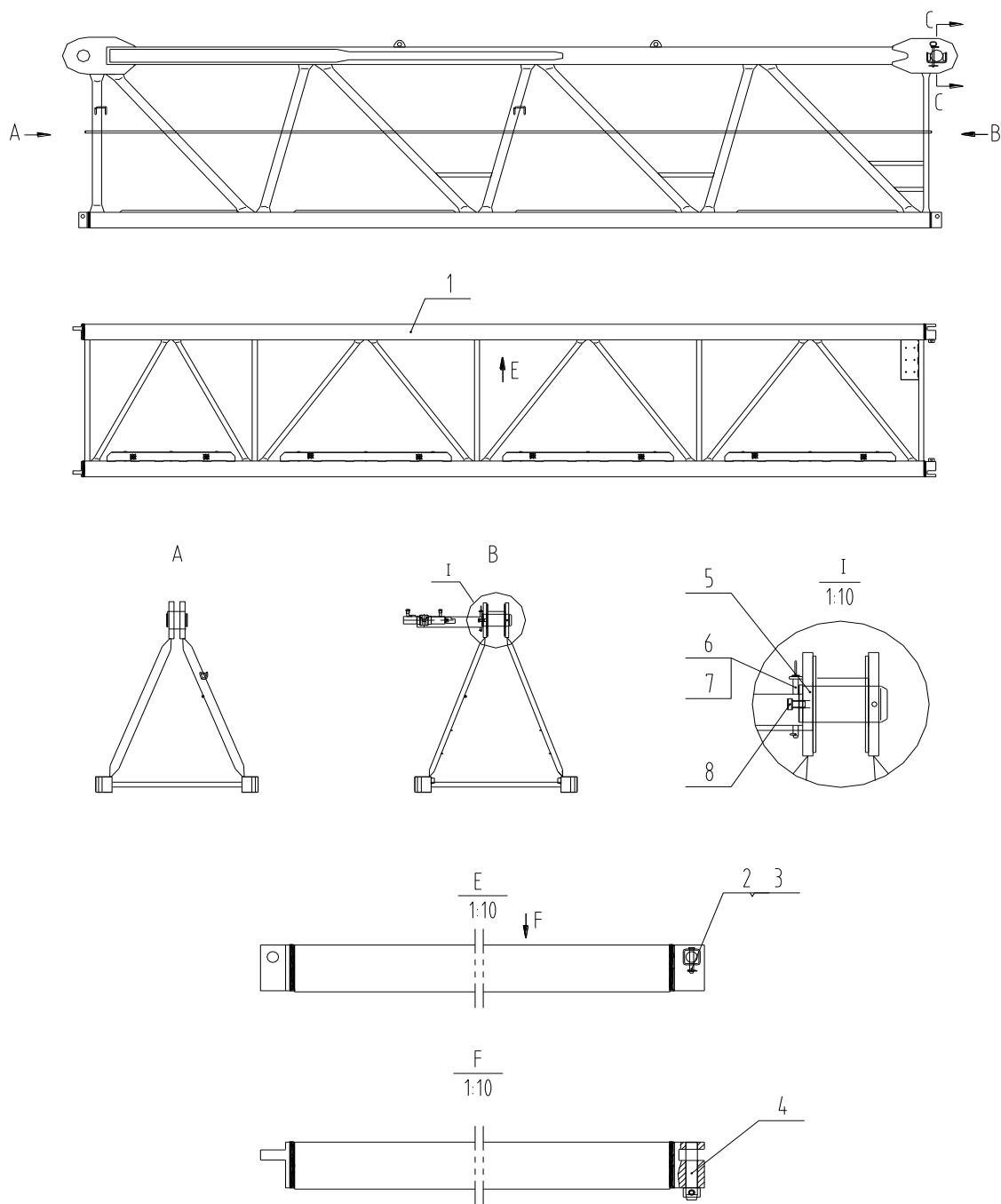


Fig. 7-16 000283005AR005000

Table 7-16 Spare parts list of Jib V

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR005100		Jib V structure		1
2	000270405BT007002		Pin	Φ16×90/105	2
3	1040500097	GB/T91-2000	Split pin	4×30	2
4	000292005AT007001		Pin	45×209/240	2
5	000283005AR005001		Pin		1
6	000263005AT003035		Safety pin		1
7	000201213A0000003		Spring pin		1
8	1040003061	GB/T5783-2000	Bolt	M30×50-8.8	1

7.3.6 JibVI

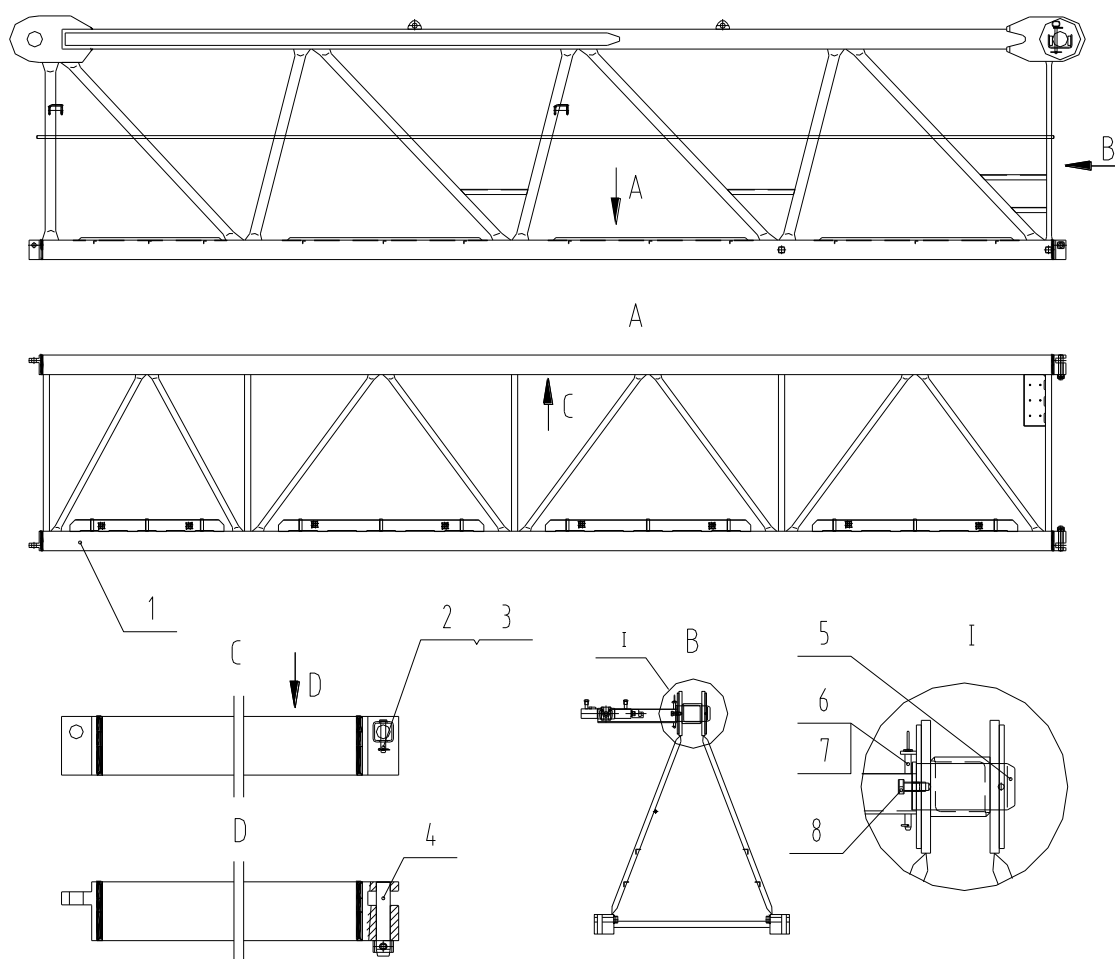


Fig. 7-17 000274005AT006000

Table 7-17 Spare parts list of JibVI

No.	Order No.	Code	Designation	Specification	Qty
1	000274005AT006100		JibVI structure		1
2	000270405BT007002		Pin	$\Phi 16 \times 90/105$	2
3	1040500097	GB/T91-2000	Split pin	4×30	2
4	000292005AT007001		Pin	45×209/240	2
5	000283005AR006001		Pin		1
6	000263005AT003035		Safety pin		1
7	000201213A0000003		Spring pin		1
8	1040003061	GB/T5783-2000	Bolt	M30×50-8.8	1

7.3.7 Jib VII

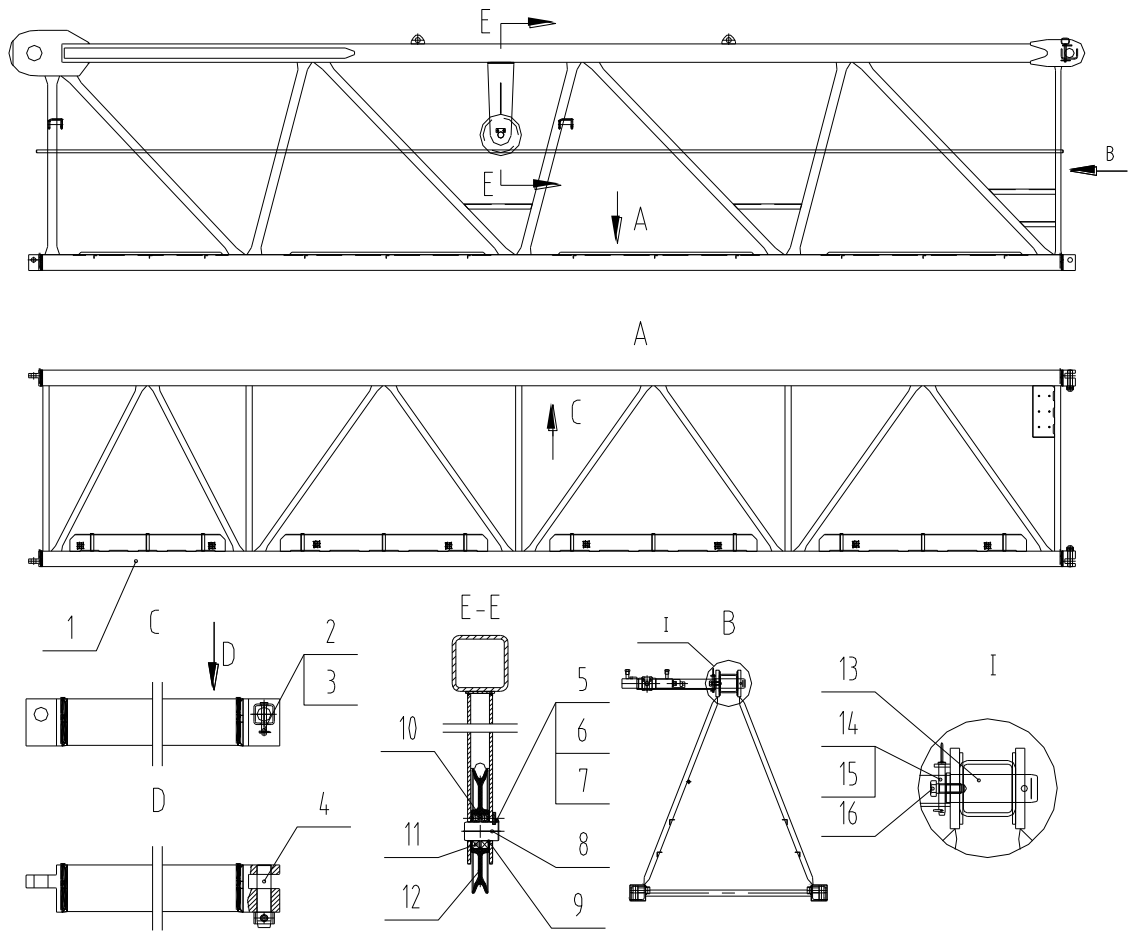


Fig. 7-18 000274005AT007000

Table 7-18 Spare parts list of JibⅦ

No.	Order No.	Code	Designation	Specification	Qty
1	000274005AT007100		JibⅦ structure		1
2	000270405BT007002		Pin	Φ16×90/105	2
3	1040500097	GB/T91-2000	Split pin	4×30	2
4	000212005AT005001		Pin	45×171/200	2
5	000283005AR004011		Pallet	t10	1
6	1040000114	GB/T5783-2000	Bolt	M10×25-8.8	2
7	1040300067	GB/T93-1987	Spring washer	10	2
8	000270405DT001002		Pulley shaft	Φ60×82/110	1
9	000209605A0000020	FDG08A.01-7	Shaft sleeve		2
10	1040300283	GB/T893.2-1986	Retainer ring	110	2
11	1050201562	GB/T276-2004	Deep groove ball bearing	6212-2RS1	2
12	000209906A0013000	400-340-B55-110-R8.5	Pulley		1
13	000283005AR007001		Pin		1
14	000263005AT003038		Safety pin		1
15	000201213A0000003		Spring pin		1
16	1040003061	GB/T5783-2000	Bolt	M30×50-8.8	1

7.3.8 Jib VIII

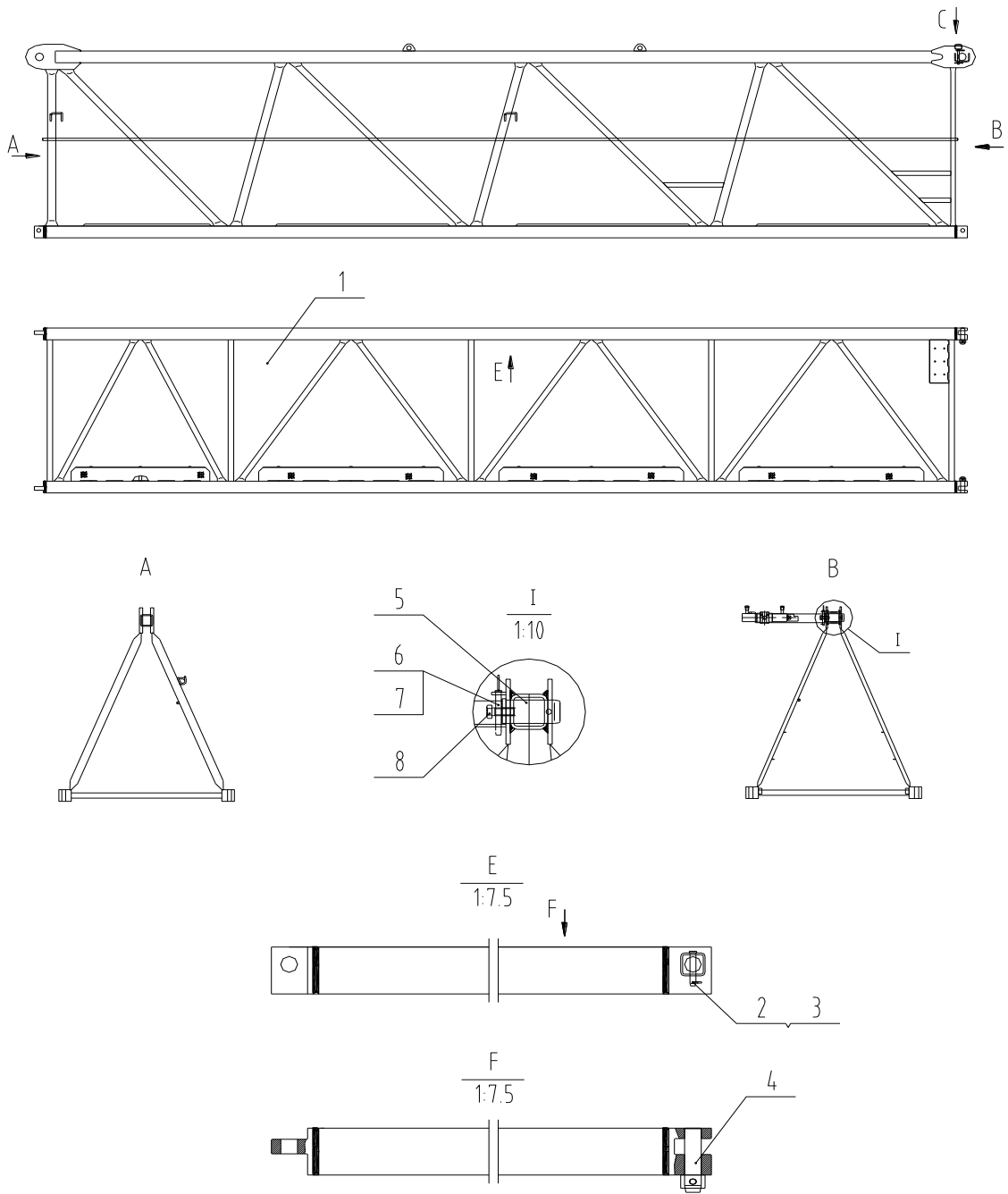


Fig. 7-19 000283005AR008000

Table 7-19 Spare parts list of JibⅧ

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR008100		JibⅧ structure		1
2	000270405BT007002		Pin	Φ16×90/105	2
3	1040500097	GB/T91-2000	Split pin	4×30	2
4	000212005AT006001		Pin	45×154/185	2
5	000283005AR008001		Pin		1
6	000263005AT003038		Safety pin		1
7	000201213A0000003		Spring pin		1
8	1040003061	GB/T5783-2000	Bolt	M30×50-8.8	1

7.3.9 JibIX

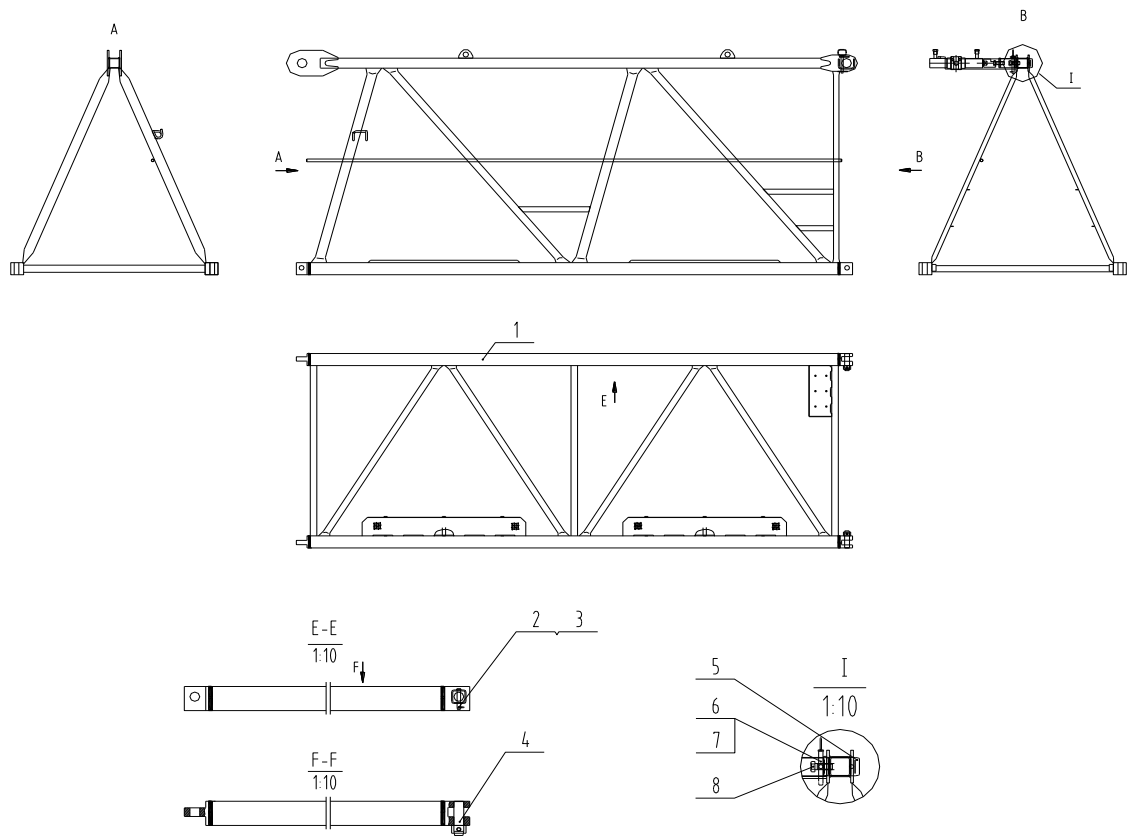


Fig. 7-20 000283005AR009000

Table 7-20 Spare parts list of JibIX

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR009100		JibIX structure		1
2	000270405BT007002		Pin	$\Phi 16 \times 90/105$	2
3	1040500097	GB/T91-2000	Split pin	4×30	2
4	000292005AT009001		Pin	45×137/167	2
5	000283005AR009001		Pin		1
6	000263005AT003038		Safety pin		1
7	000201213A0000003		Spring pin		1
8	1040003061	GB/T5783-2000	Bolt	M30×50-8.8	1

7.3.10 Jib End

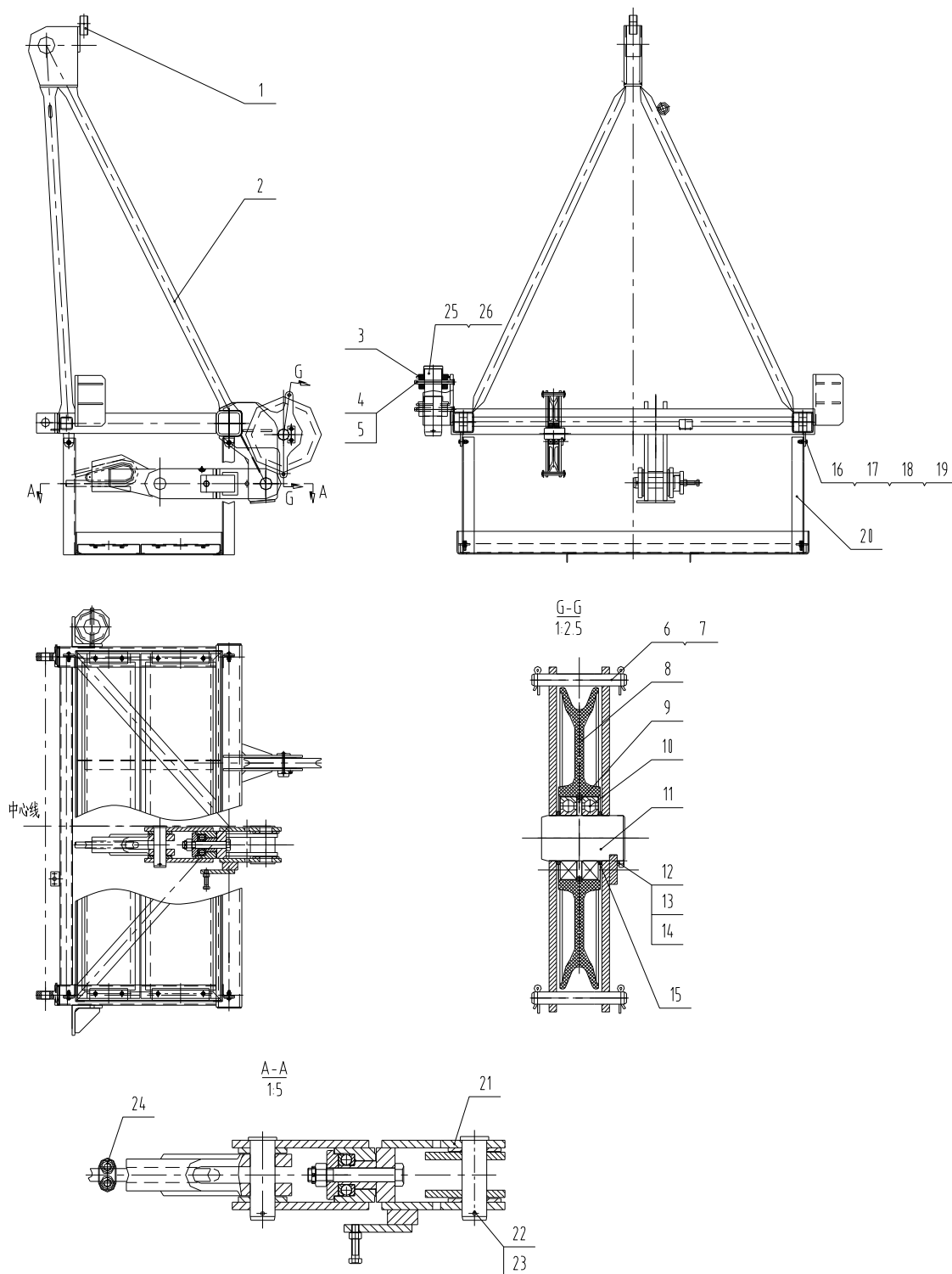


Fig. 7-21 000274005AT010000

Parts No.20 and No.21 are exploded in following drawings

Table 7-21 Spare parts list of Jib End

No.	Order No.	Code	Designation	Specification	Qty
1	1040500215	GB/T91-2000	Split pin	5×63	1
2	000274005AT010100		Jib end structure		1
3	000283005AR010001		Shaft sleeve		2
4	000209910A1041901	XZ01B-20×190/210	Pin	Φ20×190/210	2
5	1040500253	GB/T91-2000	Split pin	5×32	2
6	000209910A0161101	XZ03B-16×110/125	Pin	16×110	2
7	1040500228	GB/T91-2000	Split pin	4×32	4
8	000209906A0013000	400-340-B55-110-R8.5	Pulley		1
9	1040300283	GB/T893.2-1986	Retainer ring	110	2
10	1050201562	GB/T276-2004	Deep groove ball bearing	6212-2RS1	2
11	000270405DT001002		Pulley shaft	Φ60×82/110	1
12	000283005AR004011		Pallet	t10	1
13	1040000114	GB/T5783-2000	Bolt	M10×25-8.8	2
14	1040300067	GB/T93-1987	Spring washer	10	2
15	000209605A0000020	FDG08A.01-7	Shaft sleeve		2
16	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	4
17	1040200096	GB/T6170-2000	Nut	M12-8	4
18	1040300041	GB/T97.1-2002	Spring washer	12-200HV	4
19	1040300054	GB/T93-1987	Spring washer	12	4
20	000283005AR010300		Platform		1
21	000251005BT010200		Anti-twist device		1
22	000201705A0006303		Pin		1
23	1040500179	GB/T91-2000	Split pin	10×120	1
24	1090100590	GB/T5976-1986	Rope clip	32KTH	1
25	000283005AR010002		Pin	90×330	1
26	1040500965	GB/T91-2000	Split pin	13×110	1

7.3.10.1 Platform

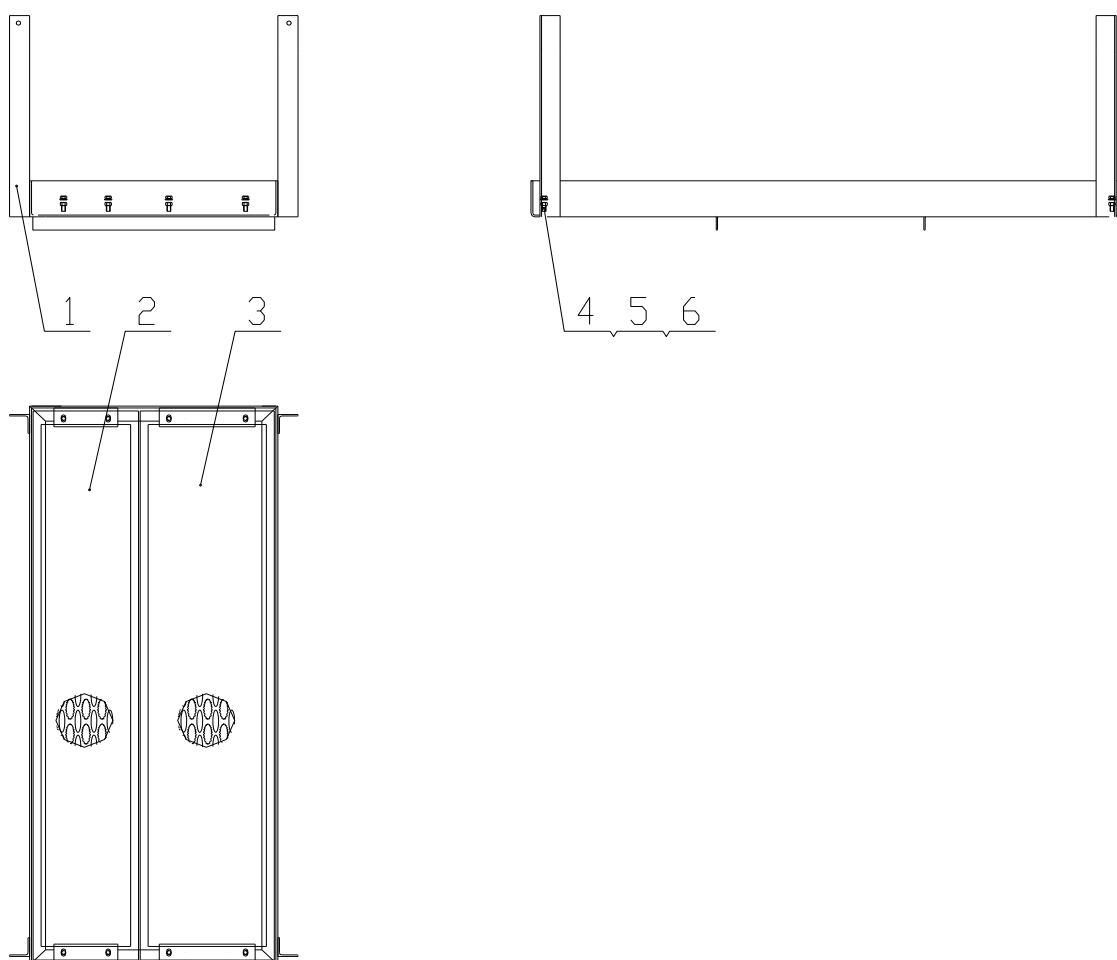


Fig. 7-22 000283005AR010300

Table 7-22 Spare parts list of Platform

No.	Order No.	Code	Designation	Specification	Qty
1	000283005AR010310		Platform structure		1
2	000283005AR010301		Pattern plate	t2	1
3	000283005AR010302		Pattern plate	t2	1
4	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	8
5	1040300651	GB/T96-1985	Washer	12-140HV	8
6	1040300054	GB/T93-1987	Spring washer	12	8

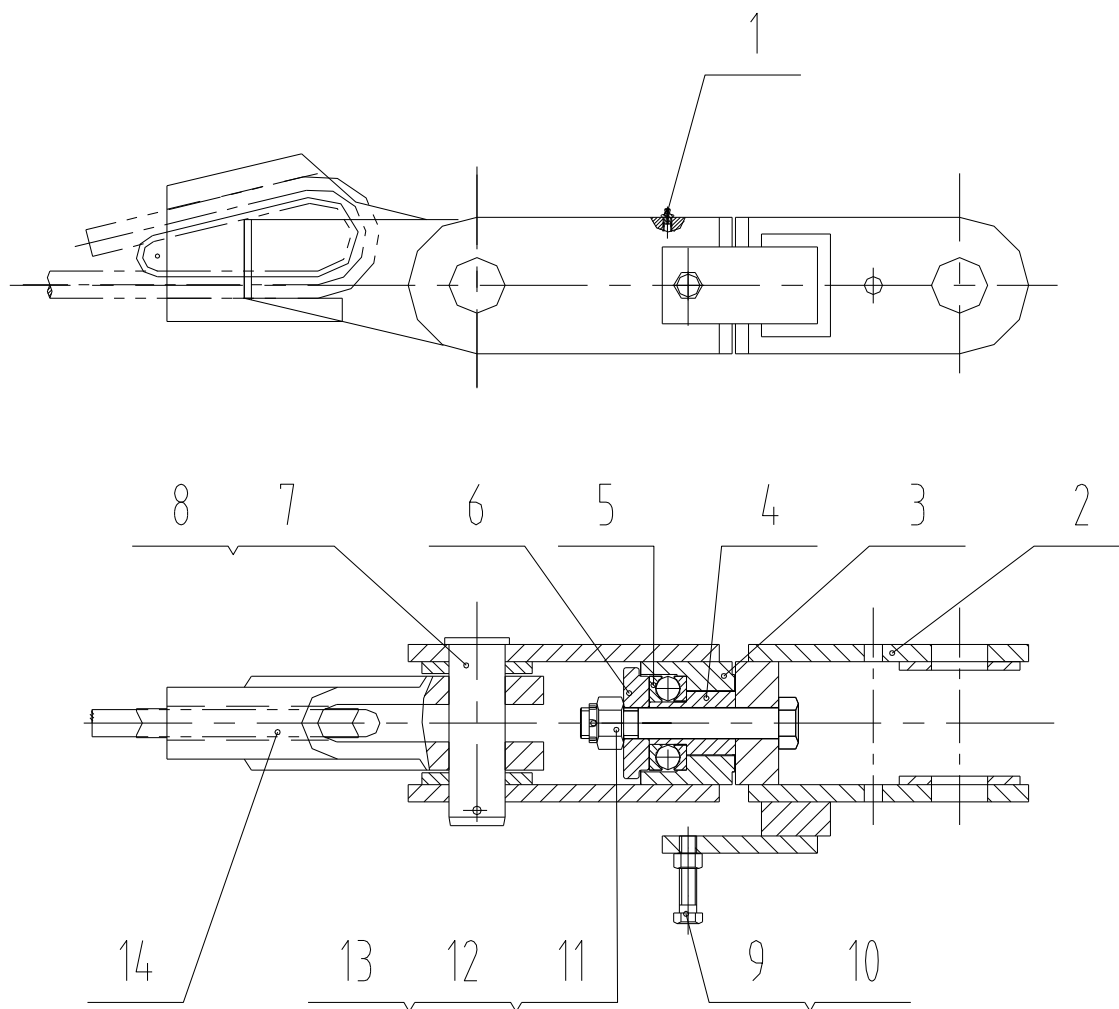
7.3.10.2 Anti-twist Device

Fig. 7-23 000291005AT010300

Table 7-23 Spare parts list of Anti-twist Device

No.	Order No.	Code	Designation	Specification	Qty
1	1080000007	JB/T7940.1-1995	Oil Cup	M10×1	2
2	000251005BT010210		Connector A		1
3	000201705A0006330		Connector B		1
4	000201705A0006301		Shaft sleeve		1
5	1050200433	GB/T301-1995	Thrust ball bearing	51410	1
6	000201105B0000914		Pressing block		1
7	000201705A0006303	XZ01D-65×195/245	Pin	65×195	1
8	1040500179	GB/T91-2000	Split pin	10×120	1
9	1040000681	GB/T5783-2000	Bolt	M20×90-8.8	1
10	1040200097	GB/T6170-2000	Nut	M20-8	1
11	1040001444	GB/T31.1-1988	Bolt	M36×230-8.8	
12	1040200824	GB/T6178-1986	Nut	M36-8	1
13	1040500224	GB/T91-2000	Split pin	6.3×63	1
14	1090100299	JW32-250	Wedge joint		1

7.4 Counter Jib

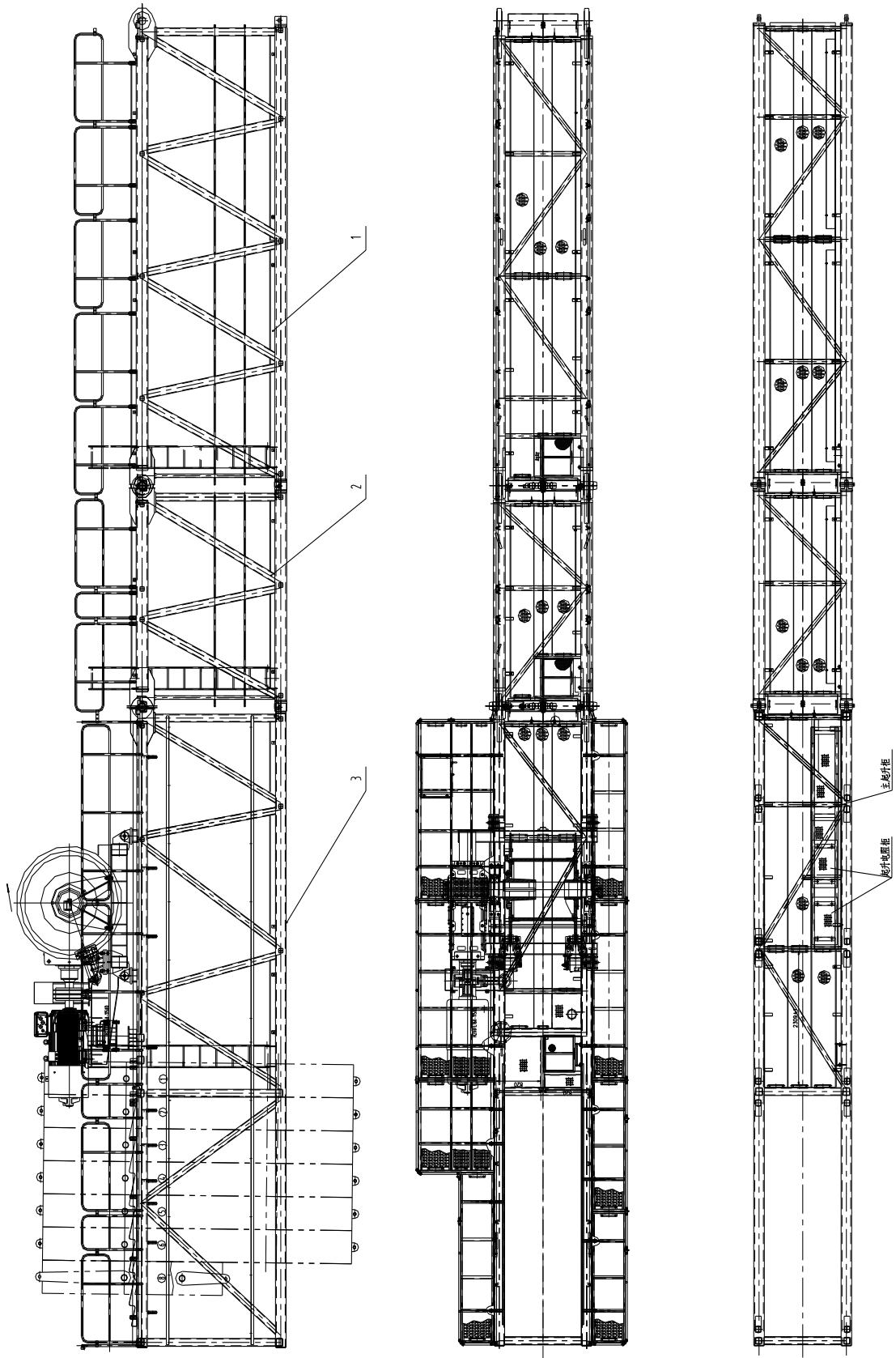
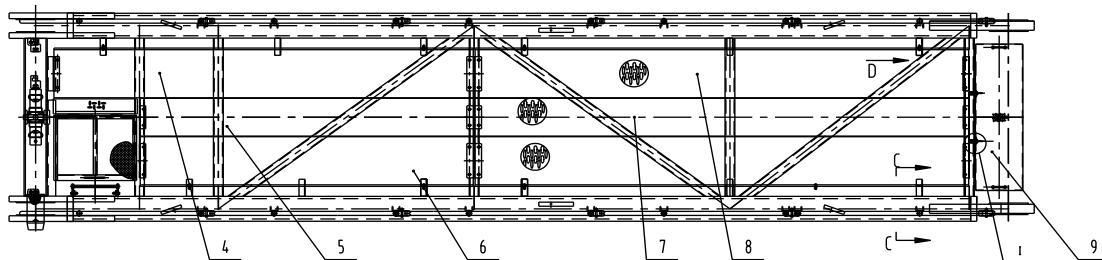
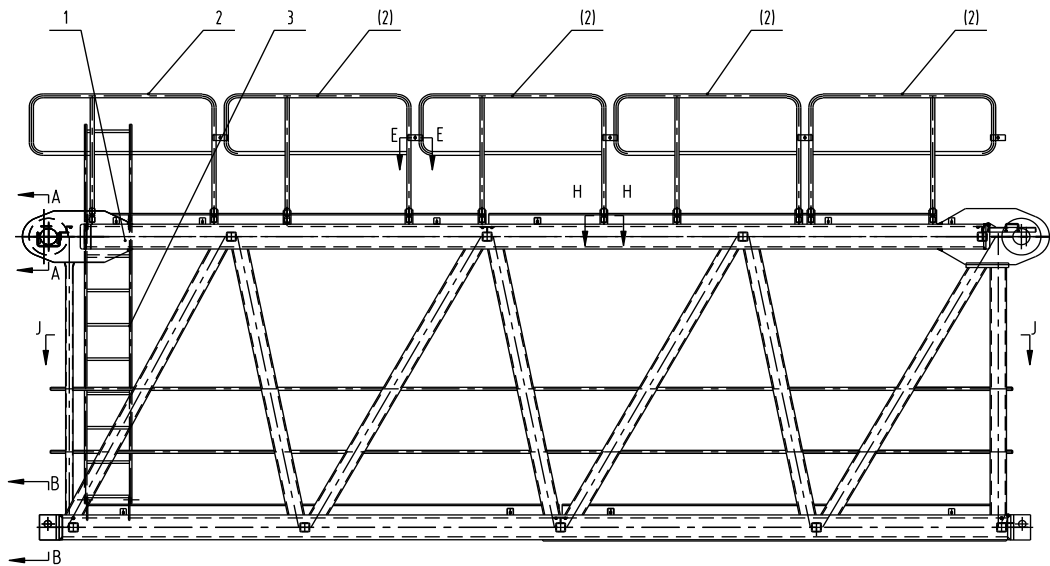


Fig. 7-24 000274001AT000000

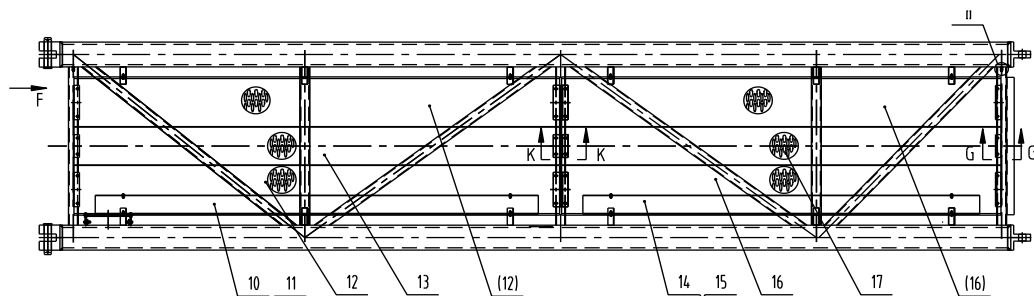
Table 7-24 Spare parts list of Counter Jib (R1300-64.01)

No.	Order No.	Code	Designation	Specification	Qty
1	000274001AT010000		Front counter-jib		1
2	000274001AT020000		Middle counter-jib		2
3	000274001AT030000		Rear counter-jib		1

7.4.1 Front Counter-jib



J-J (平衡臂底层)



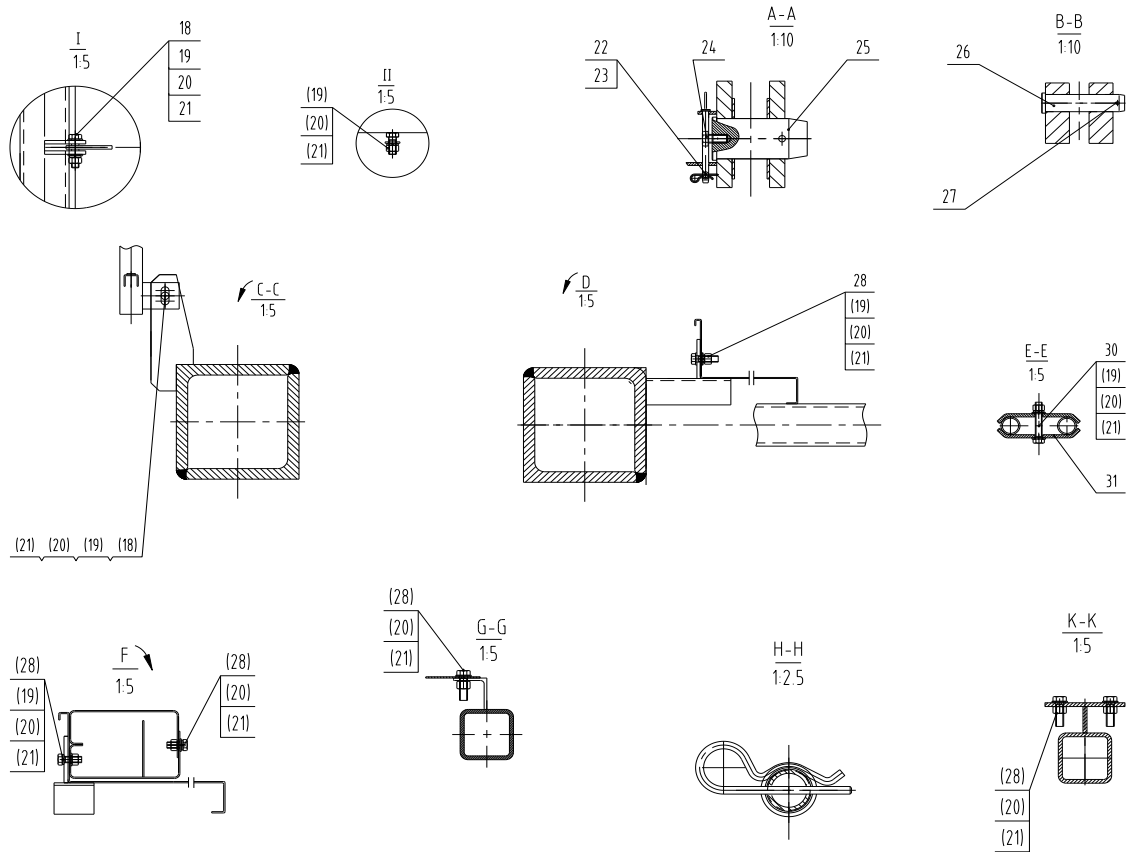
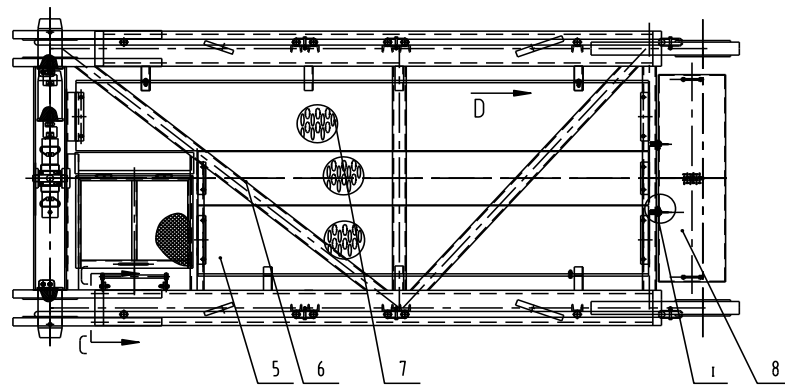
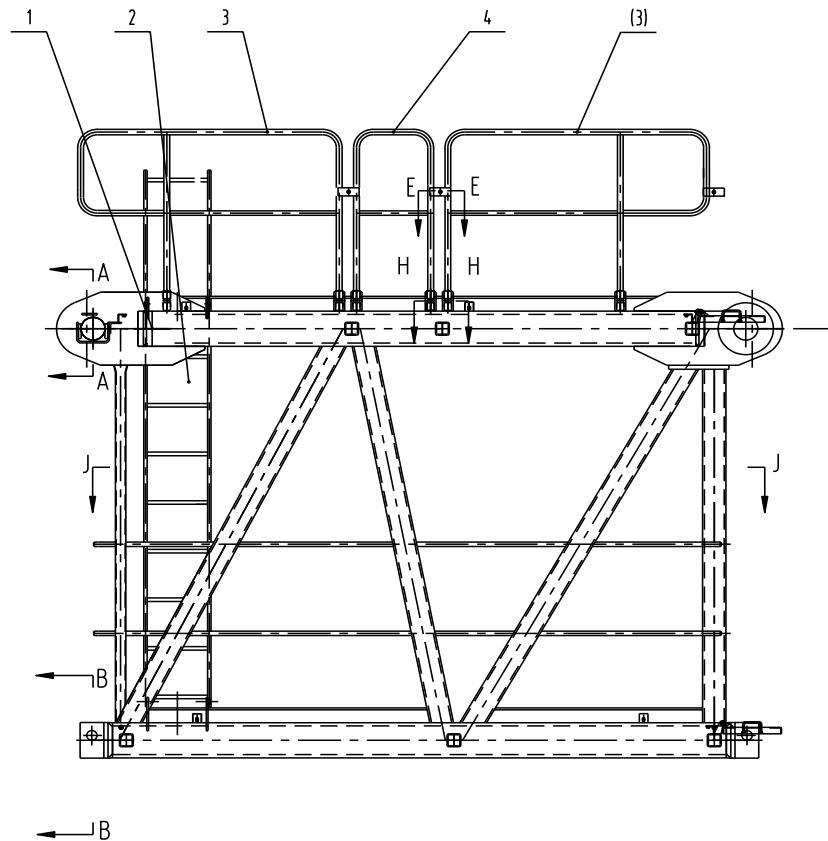


Fig. 7-25 000274001AT010000

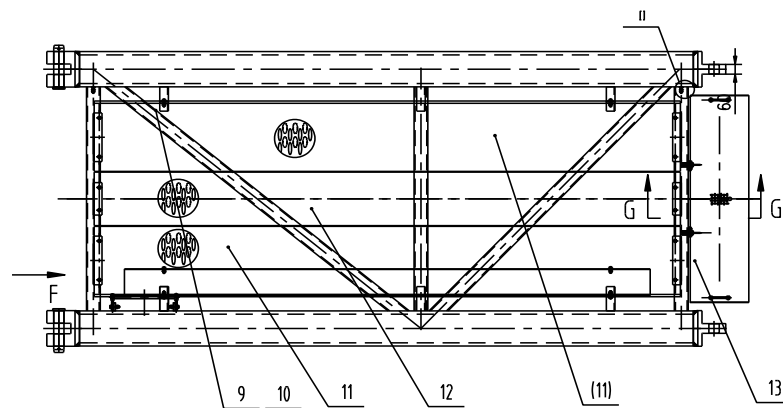
Table 7-25 Spare parts list of Front Counter-jib

No.	Order No.	Code	Designation	Specification	Qty
1	000274001AT011000		Front counter-jib structure		1
2	000209913C0015000	LGC1500B	Railing		10
3	000283001AR010010		Ladder		1
4	000283001AR010020		Upper passage 1	t2	2
5	000274001AT010010		Upper passage 2	t2	1
6	000274001AT010020		Upper passage 3	t2	1
7	000274001AT010030		Upper passage 4	t2	1
8	000283001AR010060		Upper passage 5	t2	2
9	000274001AT010040		Cover plate		1
10	000283001AR010080		Cable trunking		1
11	000283001AR010090		Cable trunking		1
12	000283001AR010100		Lower passage 1	t2	2
13	000283001AR010110		Lower passage 2	t2	1
14	000283001AR010120		Cable trunking		1
15	000283001AR010130		Cable trunking		1
16	000283001AR010140		Lower passage 3	t2	2
17	000283001AR010150		Lower passage 4	t2	1
18	1040002441	GB/T5783-2000	Bolt	M12×50-8.8	6
19	1040200096	GB/T6170-2000	Nut	M12-8	38
20	1040300054	GB/T93-1987	Washer	12	86
21	1040300041	GB/T97.1-2002	Washer	12-200HV	118
22	000263005AT003035		Safety pin		2
23	000201213A0000003		Spring pin		2
24	1040001493	GB/T5783-2000	Bolt	M30×60-8.8	2
25	000283001AR010160	140×210/310	Pin		2
26	000209910A1122351	XZ01E-60×235/265-T	Pin	60×235	2
27	1040500248	GB/T91-2000	Split pin	10×100	2
28	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	72
29	000208899A0002076	TX-6-24/35	Spring pin	Φ6×117	20
30	1040000216	GB/T5783-2000	Bolt	M12×70-8.8	10
31	000209913A6000000	LGJB2	Railing splint	t2	20

7.4.2 Middle Counter-jib



J-J(平衡臂底层)



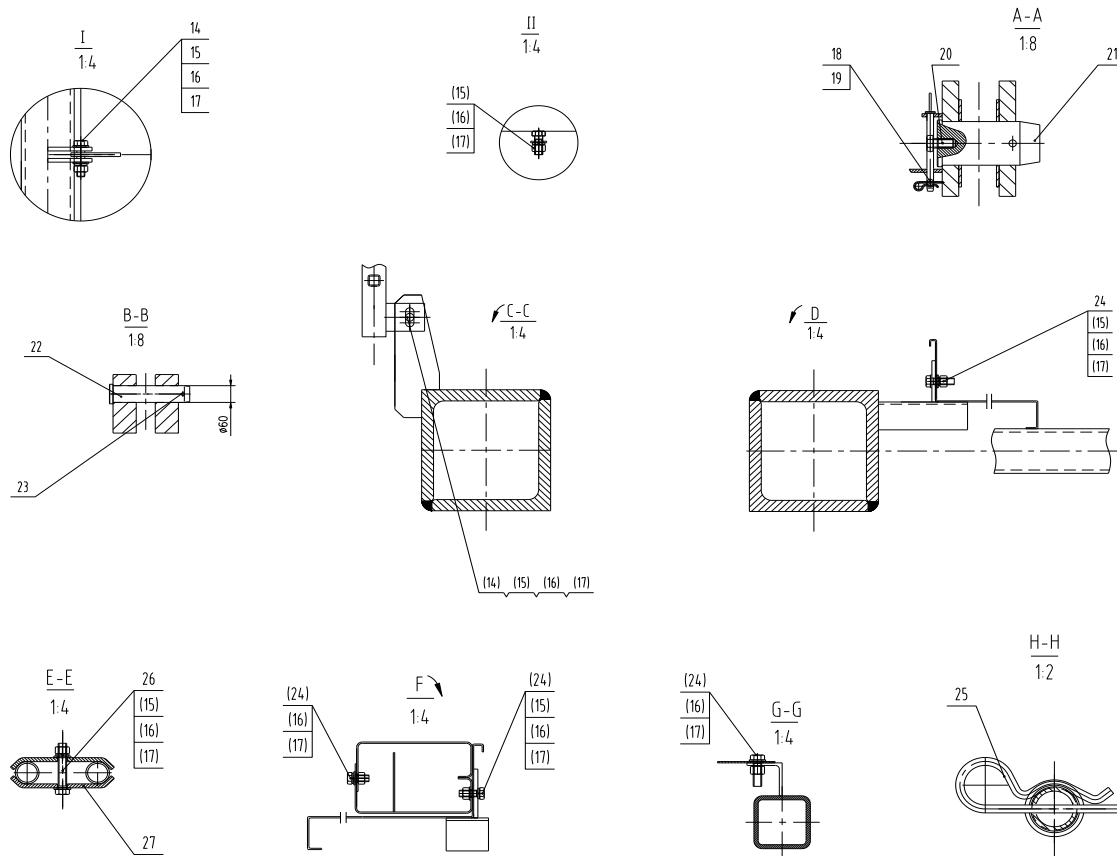
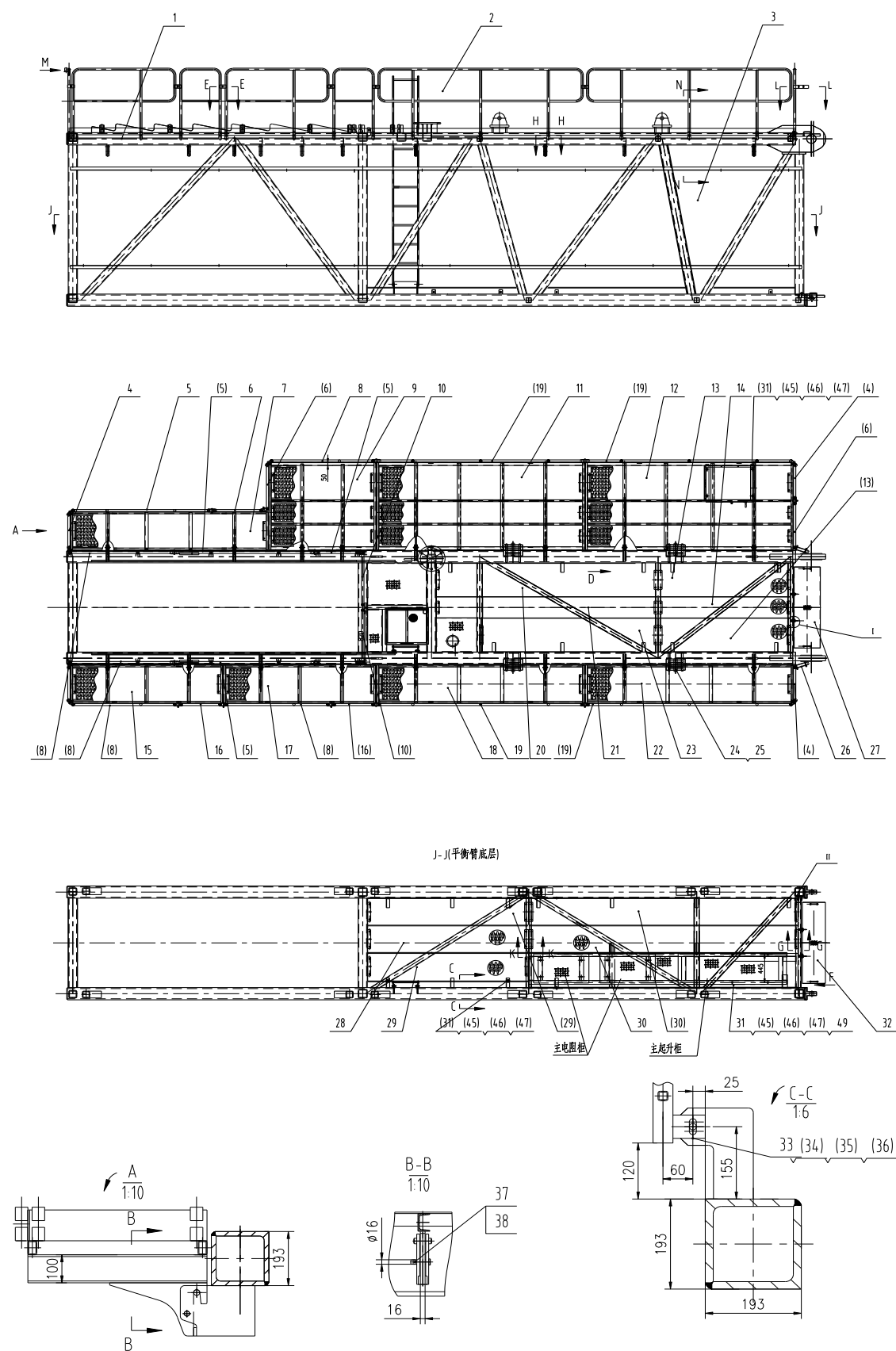


Fig. 7-26 000274001AT020000

Table 7-26 Spare parts list of Middle Counter-jib

No.	Order No.	Code	Designation	Specification	Qty
1	000274001AT021000		Middle counter-jib structure		1
2	000283001AR010010		Ladder		1
3	000209913C0015000	LGC1500B	Railing		4
4	000209913C0004300	LGA430B	Railing		2
5	000274001AT020010		Upper passage 1	t2	1
6	000274001AT020020		Upper passage 2	t2	1
7	000283001AR020030		Upper passage 3	t2	1
8	000274001AT010040		Cover plate		1
9	000283001AR020040		Cable trunking		1
10	000283001AR020050		Cable trunking		1
11	000283001AR020060		Lower passage 1	t2	2
12	000283001AR020070		Lower passage 2	t2	1
13	000274001AT020030		Cover plate		1
14	1040002441	GB/T5783-2000	Bolt	M12×50-8.8	8
15	1040200096	GB/T6170-2000	Nut	M12-8	24
16	1040300054	GB/T93-1987	Washer	12	50
17	1040300041	GB/T97.1-2002	Washer	12-200HV	72
18	000263005AT003035		Safety pin		2
19	000201213A0000003		Spring pin		2
20	1040001493	GB/T5783-2000	Bolt	M30×60-8.8	2
21	000283001AR010160	140×210/310	Pin		4
22	000209910A1122351	XZ01E- 60×235/265-T	Pin	60×235	2
23	1040500248	GB/T91-2000	Split pin	10×100	2
24	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	34
25	000208899A0002076	TX-6-24/35	Spring pin	Φ6×117	12
26	1040000216	GB/T5783-2000	Bolt	M12×70-8.8	6
27	000209913A6000000	LGJB2	Railing splint	t2	12

7.4.3 Rear Counter-jib



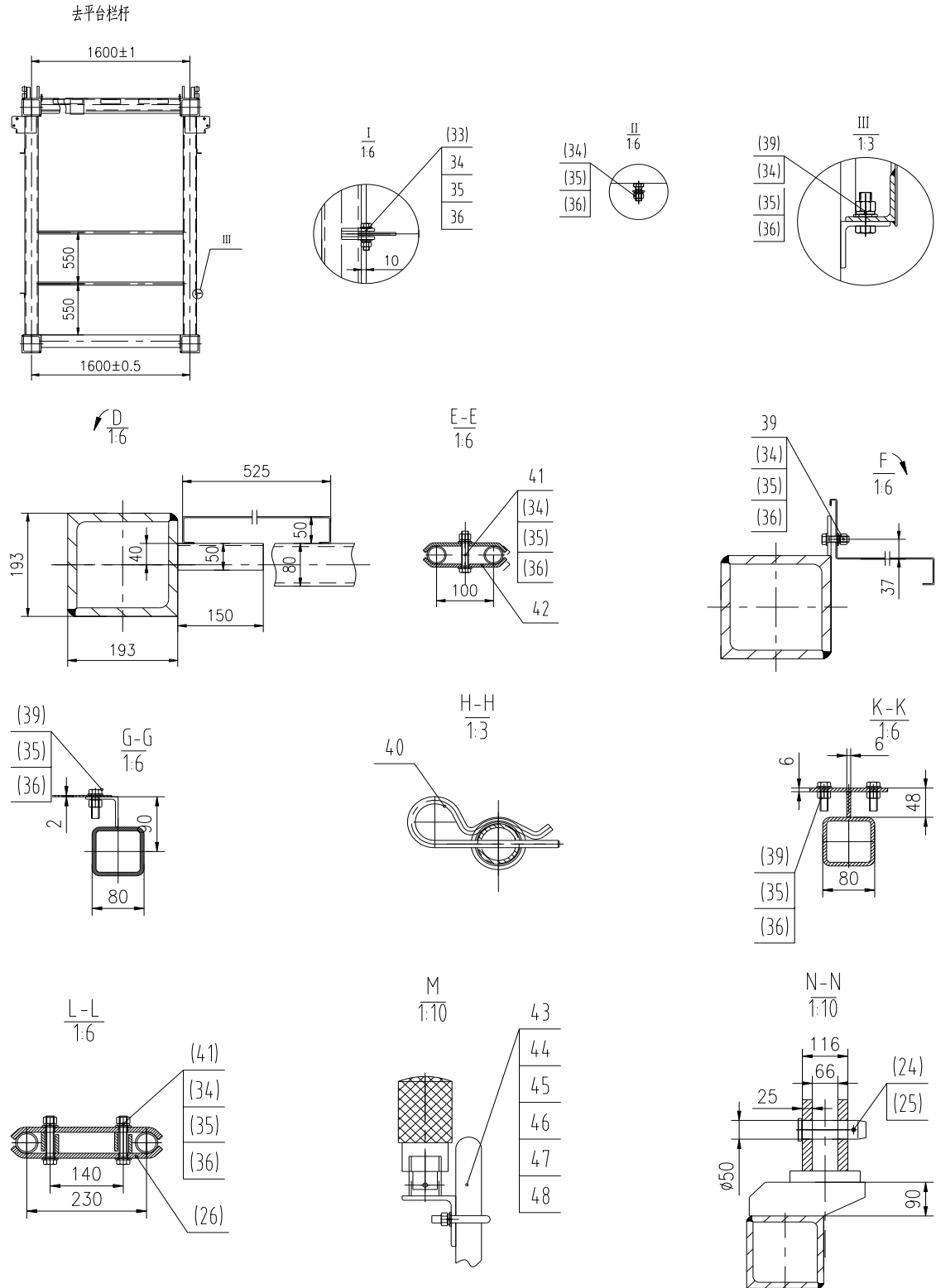


Fig. 7-27 000274001AT030000

Table 7-27 Spare parts list of Rear Counter-jib

No.	Order No.	Code	Designation	Specification	Qty
1	000274001AT031000		Rear counter-jib structure		1
2	000283001AR010010		Ladder		1
3	000251001BT201600		LOGO railing		2
4	000209913B0005300	LGA530A	Railing		4
5	000209913B0020000	LGB2000A	Railing		3
6	000209913B0007000	LGA700A	Railing		3
7	000283001AR032000		Platform I		1
8	000209913B0015000	LGC1500A	Railing		5
9	000283001AR033000		Platform II		1
10	000209913C0008200	LGA820B	Railing		2
11	000283001AR034000		Platform III		1
12	000283001AR035000		Platform IV		1
13	000283001AR030010		Upper passage 1	t2	2
14	000283001AR030020		Upper passage 2	t2	1
15	000283001AR036000		Platform V		1
16	000209913B0005800	LGA580A	Railing		4
17	000283001AR037000		Platform VI		1
18	000283001AR038000		Platform VII		1
19	000209913B0030000	LGB3000A	Railing		4
20	000274001AT030010		Upper passage 3	t2	1
21	000274001AT030020		Upper passage 4	t2	1
22	000283001AR039000		Platform VIII		1
23	000274001AT030050		Upper passage 5	t2	1
24	1040500248	GB/T91-2000	Split pin	10×100	8
25	000209910A1101291	XZ01C-50×130/170	Pin	50×130	4
26	000251701AT000003		Railing splint	t6	4
27	000274001AT010040		Cover plate		1
28	000274001AT030030		Lower passage 3	t2	1
29	000274001AT030040		Lower passage 1	t2	2
30	000283001AR030060		Lower passage 2	t2	2
31	1040000122	GB/T5783-2000	Bolt	M10×35-8.8	28
32	000274001AT020030		Cover plate		1
33	1040002441	GB/T5783-2000	Bolt	M12×50-8.8	8
34	1040200096	GB/T6170-2000	Nut	M12-8	65

No.	Order No.	Code	Designation	Specification	Qty
35	1040300054	GB/T93-1987	Washer	12	143
36	1040300041	GB/T97.1-2002	Washer	12-200HV	113
37	000209938A0000060	TX-4-16/20	Spring pin		16
38	000209910A0160501	XZ01B-16×50/65	Pin	16×50	16
39	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	76
40	000208899A0002076	TX-6-24/35	Spring pin	Φ6×117	54
41	1040000216	GB/T5783-2000	Bolt	M12×70-8.8	28
42	000209913A6000000	LGJB2	Railing splint	t2	48
43	000209915A0001000	ZADZ	Obstacle light seat		1
44	1040000696	JB/ZQ4321-1997	U-Bolt	33-Zn	2
45	1040300061	GB/T97.1-2002	Washer	10-200HV	30
46	1040200113	GB/T6170-2000	Nut	M10-8	30
47	1040300067	GB/T93-1987	Washer	10	30
48	1040500233	GB/T91-2000	Split pin	5×40	1
49	1040300245	GB/T853-1988	Washer	10	10

7.5 Derrick

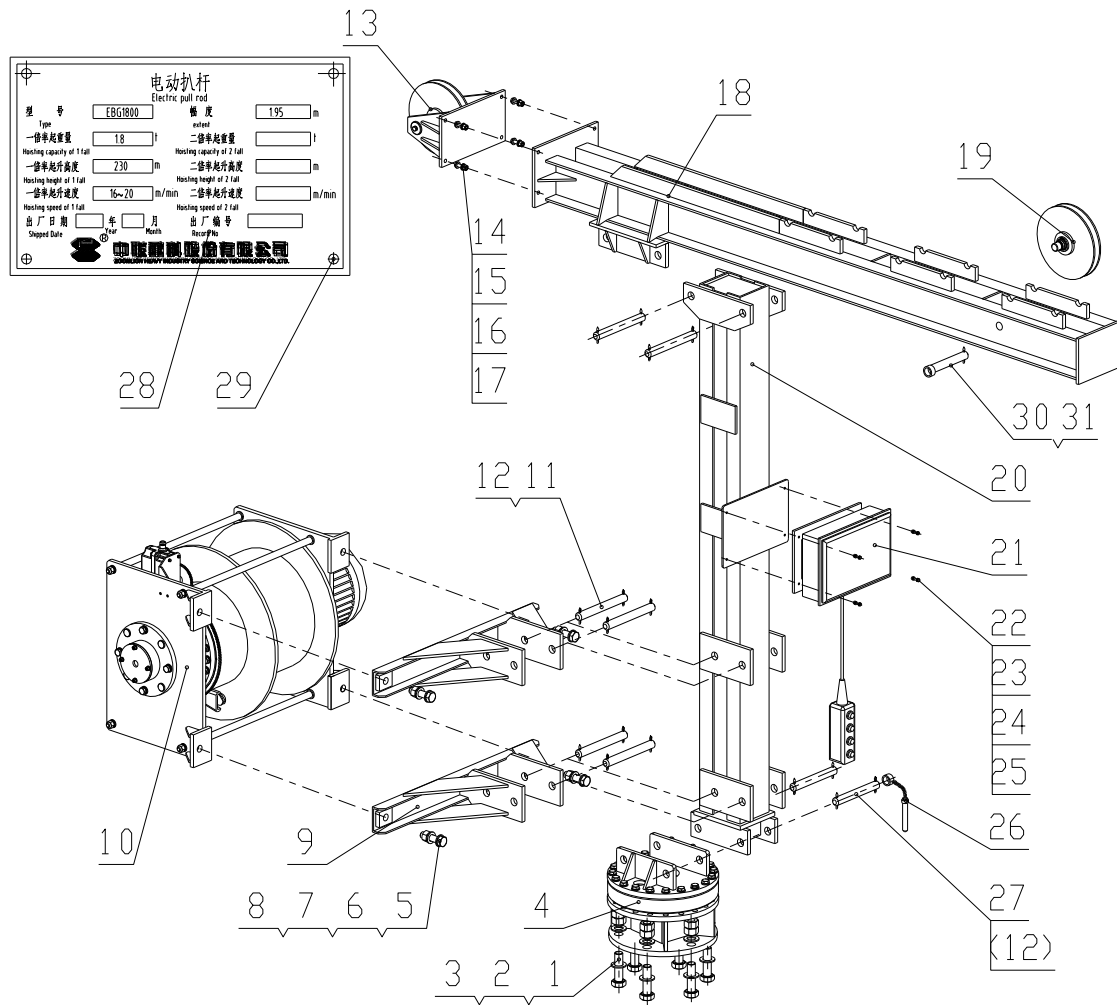


Fig. 7-28 000209914A8400000

Parts No.4, No.13, No.19 and No.26 are exploded in following drawings

Table 7-28 Spare parts list of Derrick

No.	Order No.	Code	Designation	Specification	Qty
1	1040000758	GB/T5782-2000	Bolt	M30×110-8.8	6
2	1040200197	GB/T6170-2000	Nut	M30-8	12
3	1040300074	GB/T97.1-2002	Washer	30-200HV	12
4	000209914A8201000		Rotating seat		1
5	1040000270	GB/T5782-2000	Bolt	M24×90-8.8	4
6	1040200102	GB/T6170-2000	Nut	M24-8	4
7	1040300050	GB/T97.1-2002	Washer	24-200HV	8
8	1040300049	GB/T93-1987	Spring Washer	24	4
9	000209914A8403000		Installing support		2
10	000209914A8402000	1.8t/230m	Luffing mechanism		1
11	000209910A4062401	XZ03C- 30×240/270	Lock pin		6
12	1040500040	GB/T91-2000	Pin	6.3×50	16
13	000209914A8203000		Rope-out pulley		1
14	1040000169	GB/T5783-2000	Bolt	M12×45-8.8	4
15	1040200096	GB/T6170-2000	Nut	M12-8	4
16	1040300041	GB/T97.1-2002	Washer	12-200HV	8
17	1040300054	GB/T93-1987	Spring Washer	12	4
18	000209914A8407000		Derrick cantilever		1
19	000209914A8408000		Fixed pulley		1
20	000209914A8401000		Derrick upright		1
21	00020072711A01000		Electric derrick (7.5kW)		1
22	1040000076	GB/T5783-2000	Bolt	M6×25-8.8	4
23	1040200111	GB/T6170-2000	Nut	M6-8	4
24	1040300051	GB/T97.1-2002	Washer	6-200HV	8
25	1040300062	GB/T93-1987	Spring Washer	6	4
26	000209914A8206000		Locating pin		1
27	000209910A4062101		Pin		2
28	000209914A8400003		Nameplate		1
29	1040400087	GB/T827-1986	Rivet	3×8	4
30	1040500097	GB/T91-2000	Pin	4×30	1
31	000209914A8400002	XZ01A- 16×125/142	Pin		1

7.5.1 Rotating Seat

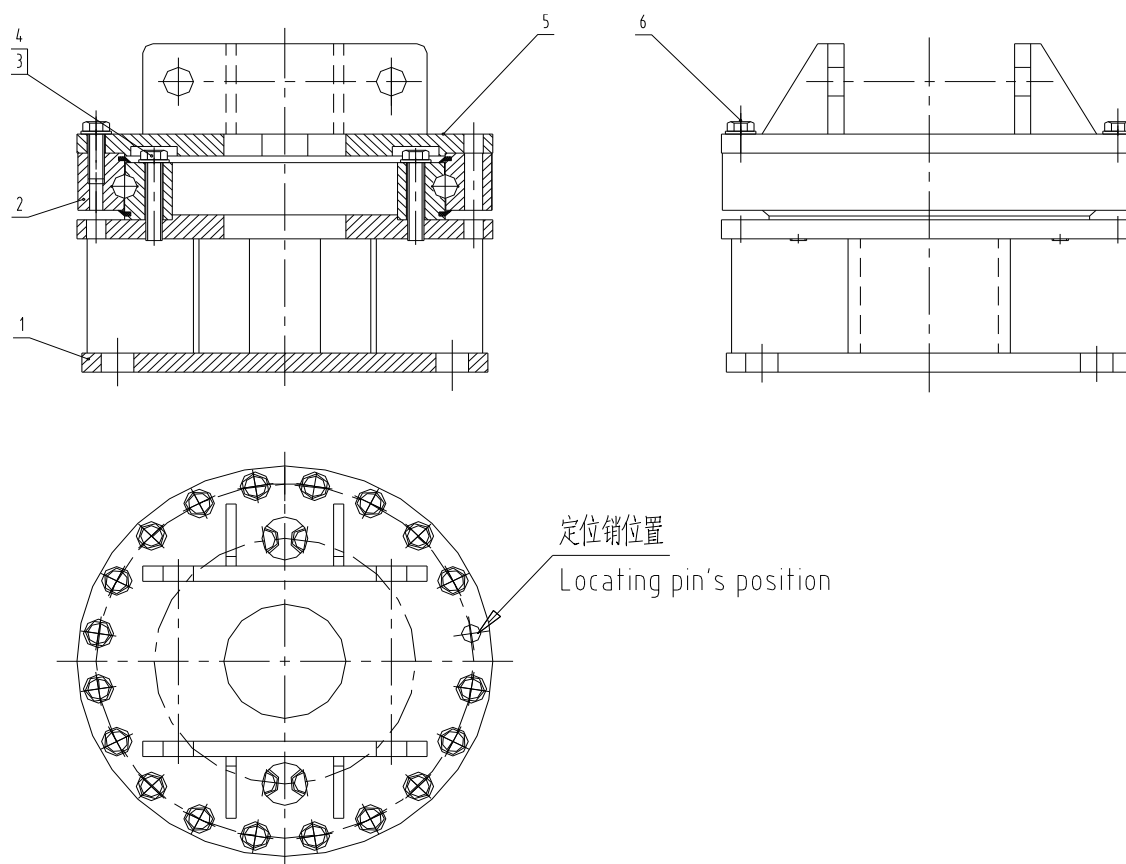


Fig. 7-29 000274001AT030000

Table 7-29 Spare parts list of Rotating Seat

No.	Order No.	Code	Designation	Specification	Qty
1	000209914A8201100		Bottom rotating seat		1
2	1031500246	JB/T2300-2011	Rotating support	010.25.315.03	1
3	1040001637	GB/T5783-2000	Bolt	M16×85-8.8	20
4	1040300052	GB/T97.1-2002	Washer	16-200HV	39
5	000209914A8201200		Upper rotating seat		1
6	1040000198	GB/T5783-2000	Bolt	M16×50-8.8	19

7.5.2 Rope-out Pulley

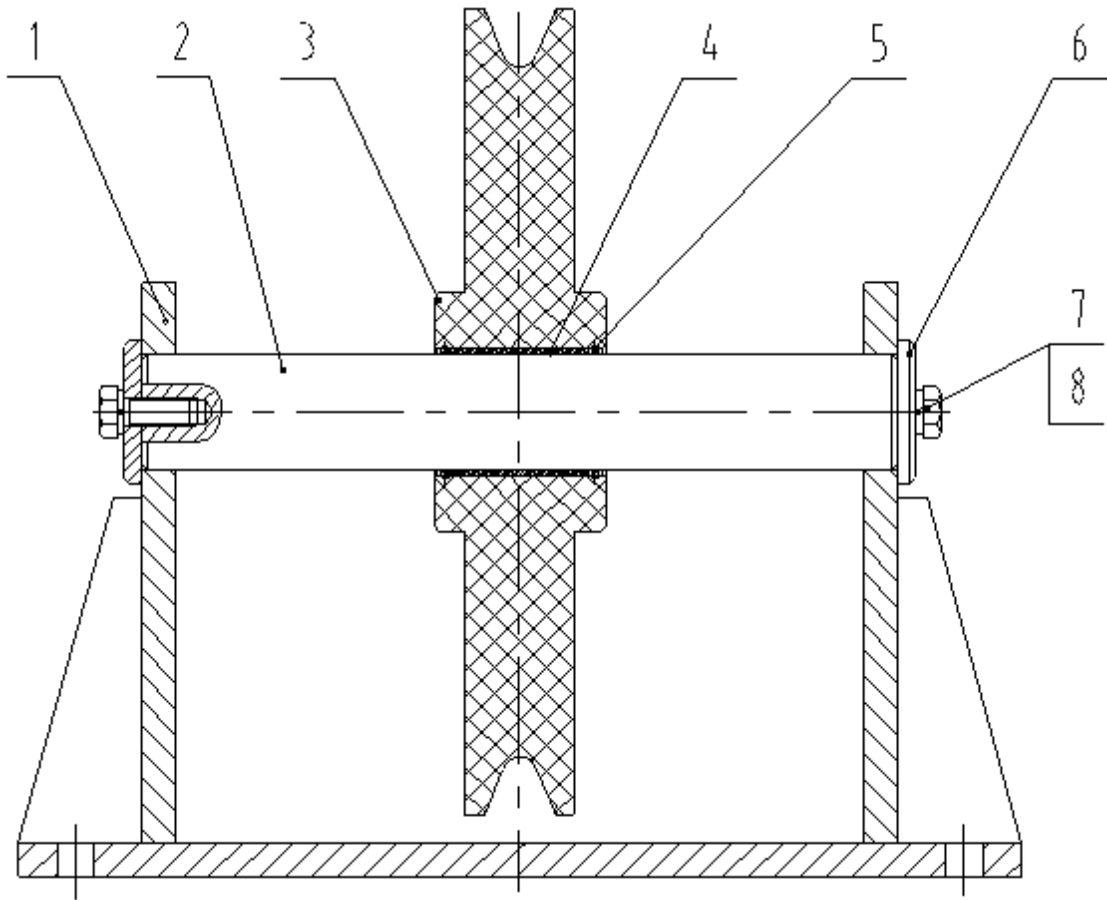


Fig. 7-30 000209914A8203000

Table 7-30 Spare parts list of Rope-out Pulley

No.	Order No.	Code	Designation	Specification	Qty
1	000209914A8203100		Shaft support		1
2	000209914A8203001		Pulley shaft		1
3	000209914A8203002		Pulley		1
4	1059900128	SF-1	Self-lubricating bearing	4050	1
5	1040301935	GB/T895.1-1986	Retainer ring for hole	45	2
6	000209914A8203003		Shaft-end plate		2
7	1040000114	GB/T5783-2000	Bolt	M10×25-8.8	2
8	1040300067	GB/T93-1987	Washer	10	2

7.5.3 Fixed Pulley

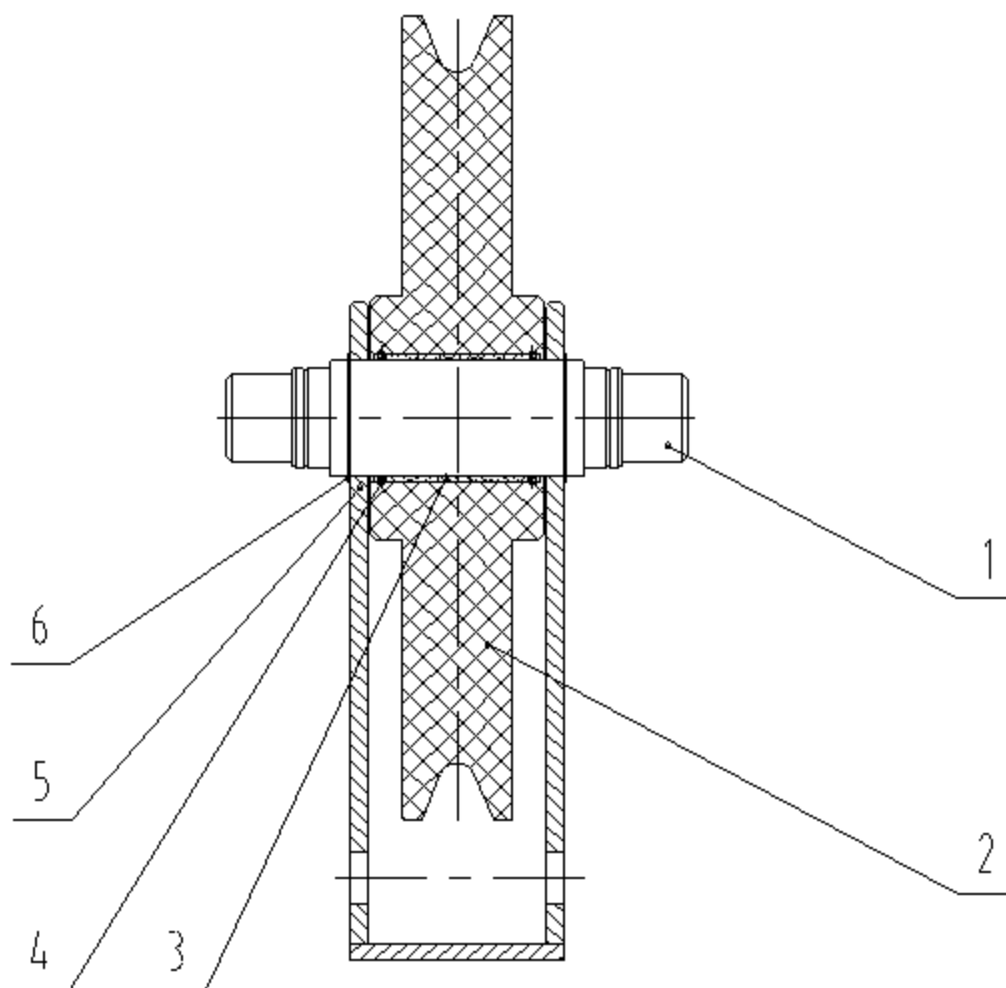


Fig. 7-31 000209914A8408000

Table 7-31 Spare parts list of Fixed Pulley

No.	Order No.	Code	Designation	Specification	Qty
1	000209914A8205001		Fixed pulley shaft		1
2	000209914A8203002		Pulley		1
3	1059900128	SF-1	Self-lubricating bearing	4050	1
4	1040301935	GB/T895.1-1986	Retainer ring for hole	45	2
5	000209914A8408100		Spacer seat		1
6	1040300096	GB/T894.1-1986	Retainer ring	40	2

7.5.4 Locating Pin

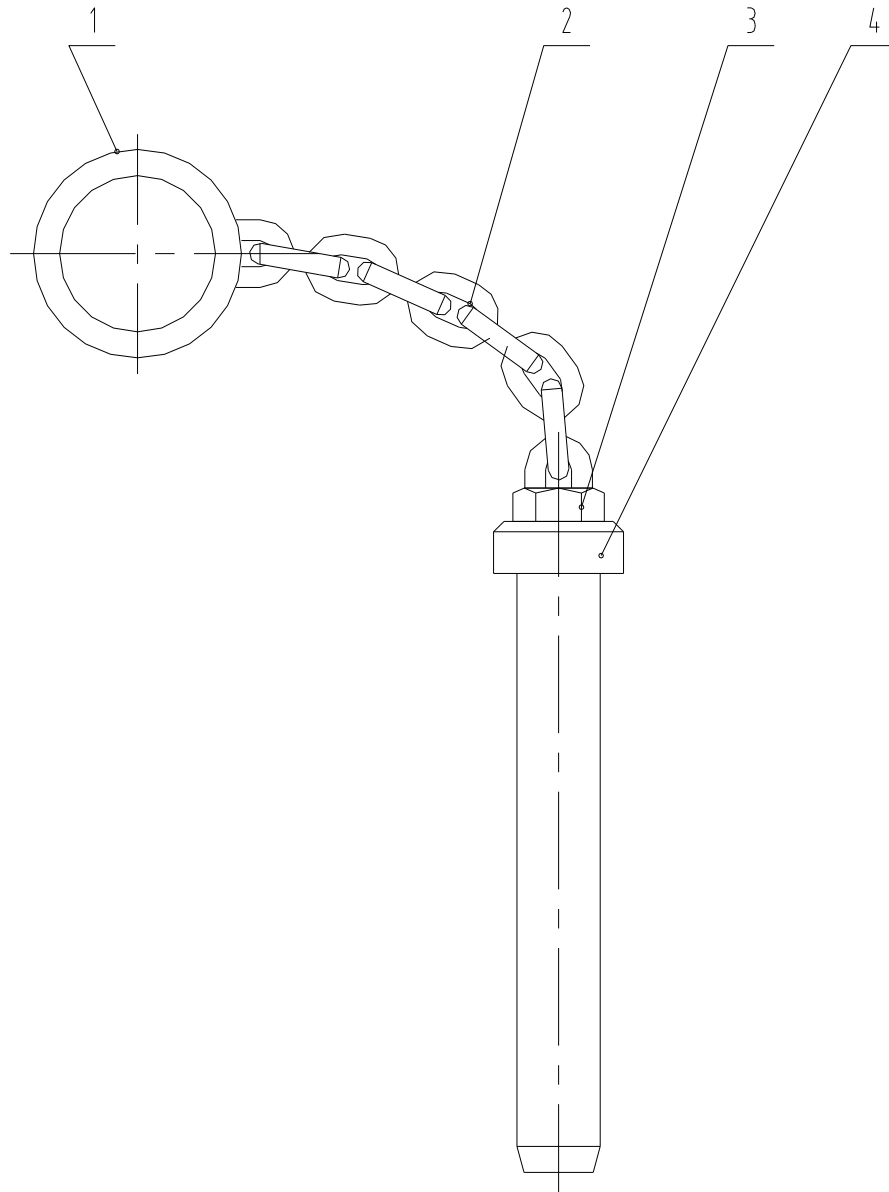


Fig. 7-32 000209914A8206000

Table 7-32 Spare parts list of Locating Pin

No.	Order No.	Code	Designation	Specification	Qty
1	000209914A8206005		Sleeve		1
2	1090100559	JB/T8108.2-1999	Chain for lifting	Φ4-252(21)	1
3	1040000116	GB/T5783-2000	Bolt	M10×20-8.8	1
4	000209914A8206002		Pin		1

7.6 Turntable

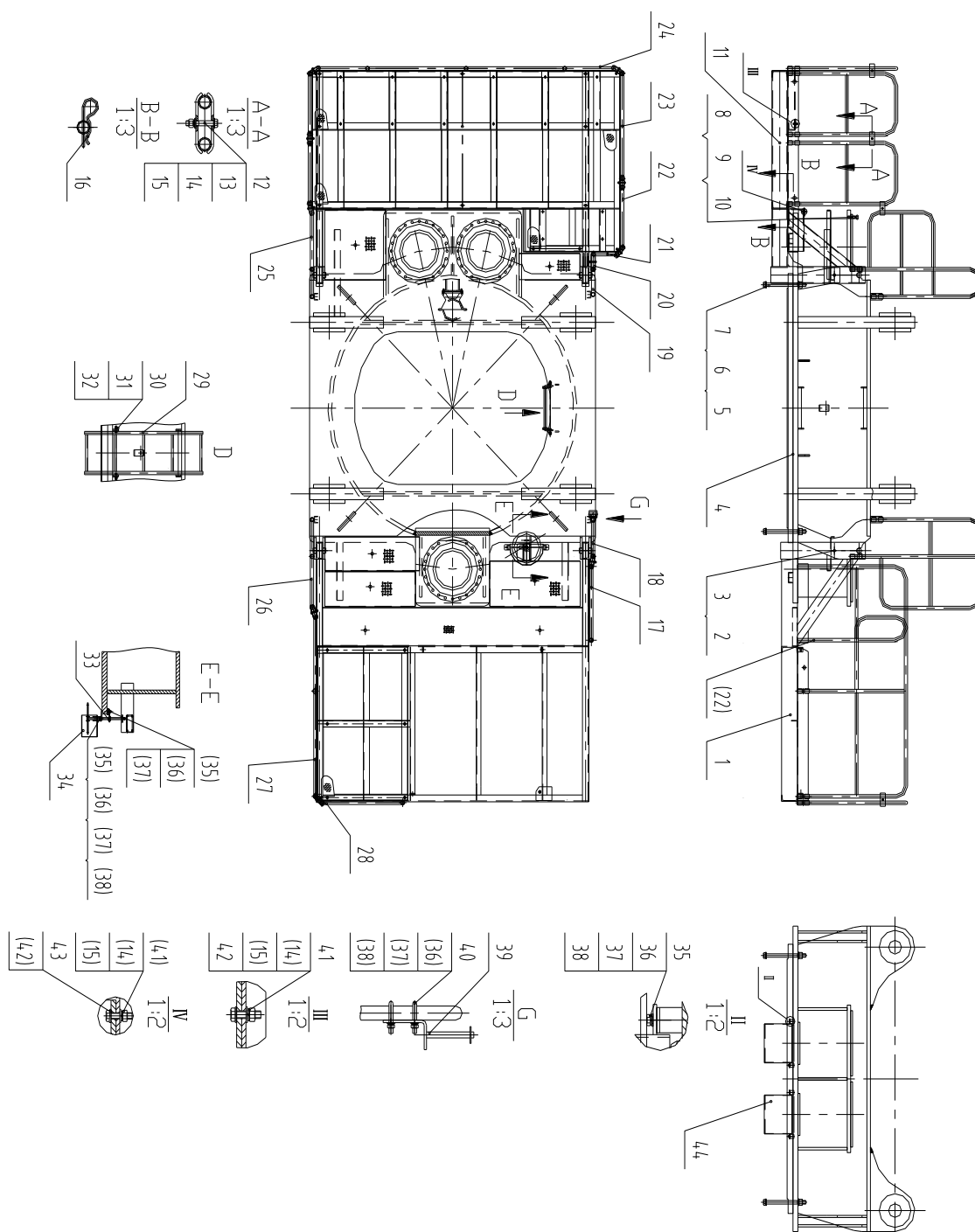


Fig. 7-33 000274009AT000000

Table 7-33 Spare parts list of Turntable (R1300-64.09)

No.	Order No.	Code	Designation	Specification	Qty
1	000274009AT002000		Cabin platform		1
2	000201213A0000003		Spring pin		4
3	000209910A1041201	XZ01B- 20×120/140	Pin	20×120	4
4	000274009AT001000		Turntable structure		1
5	000241109AHV00003		High-strength washer	33	160
6	000241109AHV00002		High-strength nut	M33×2	80
7	1040008571	GB/T5785-2000	High-strength bolt	M33×2×410-10.9	80
8	1040300050	GB/T97.1-2002	Washer	24-200HV	63
9	1040300049	GB/T93-1987	Washer	24	63
10	1040000656	GB/T5783-2000	Bolt	M24×90-8.8	63
11	000274009AT003000		Electric control cabinet platform		1
12	000209913A6000000	LGJB2	Railing splint	t2	18
13	1040000899	GB/T5782-2000	Bolt	M12×70-8.8	10
14	1040300054	GB/T93-1987	Spring washer	12	22
15	1040200096	GB/T6170-2000	Nut	M12-8	44
16	000208899A0002076	TX-6-24/35	Spring pin	Φ6×117	25
17	000209913C0007000	LGA700B	Railing		1
18	000274009AT000500		Railing		1
19	000274009AT000600		Railing		1
20	000280209AT000001		Railing splint		2
21	000274009AT000200		Railing		1
22	000209913C0005800	LGA580B	Railing		3
23	000209913D0010000	LGA1000C	Railing		1
24	000209913C0030000	LGB3000B	Railing		1
25	000274009AT000300		Railing r		1
26	000274009AT000400		Railing		1
27	000292009AT000400		Railing		1
28	000209913C0008200	LGA820B	Railing		1
29	000292009AT000900		Ladder		1
30	1040000198	GB/T5783-2000	Bolt	M16×50-8.8	4
31	1040200110	GB/T6170-2000	Nut	M16-8	4
32	1040300065	GB/T93-1987	Washer	16	4
33	000292009AT000002		Limiter support	t8	1
34	000251009BT000040		Limiter cover		1
35	1040000122	GB/T5783-2000	Bolt	M10×35-8.8	8
36	1040300061	GB/T97.1-2002	Washer	10-200HV	12
37	1040300067	GB/T93-1987	Washer	10	12

No.	Order No.	Code	Designation	Specification	Qty
38	1040200113	GB/T6170-2000	Nut	M10-8	10
39	000221601AT000010		Installing seat		1
40	1040000696	JB/ZQ4321-1997	U-Bolt	33-Zn	2
41	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	16
42	1040300081	GB/T96.1-2002	Washer	12-140HV	20
43	1040300235	GB/T853-1988	Washer	12	4
44	000292009AT000700		Slewing mechanism cover		2

7.7 Bottom Support

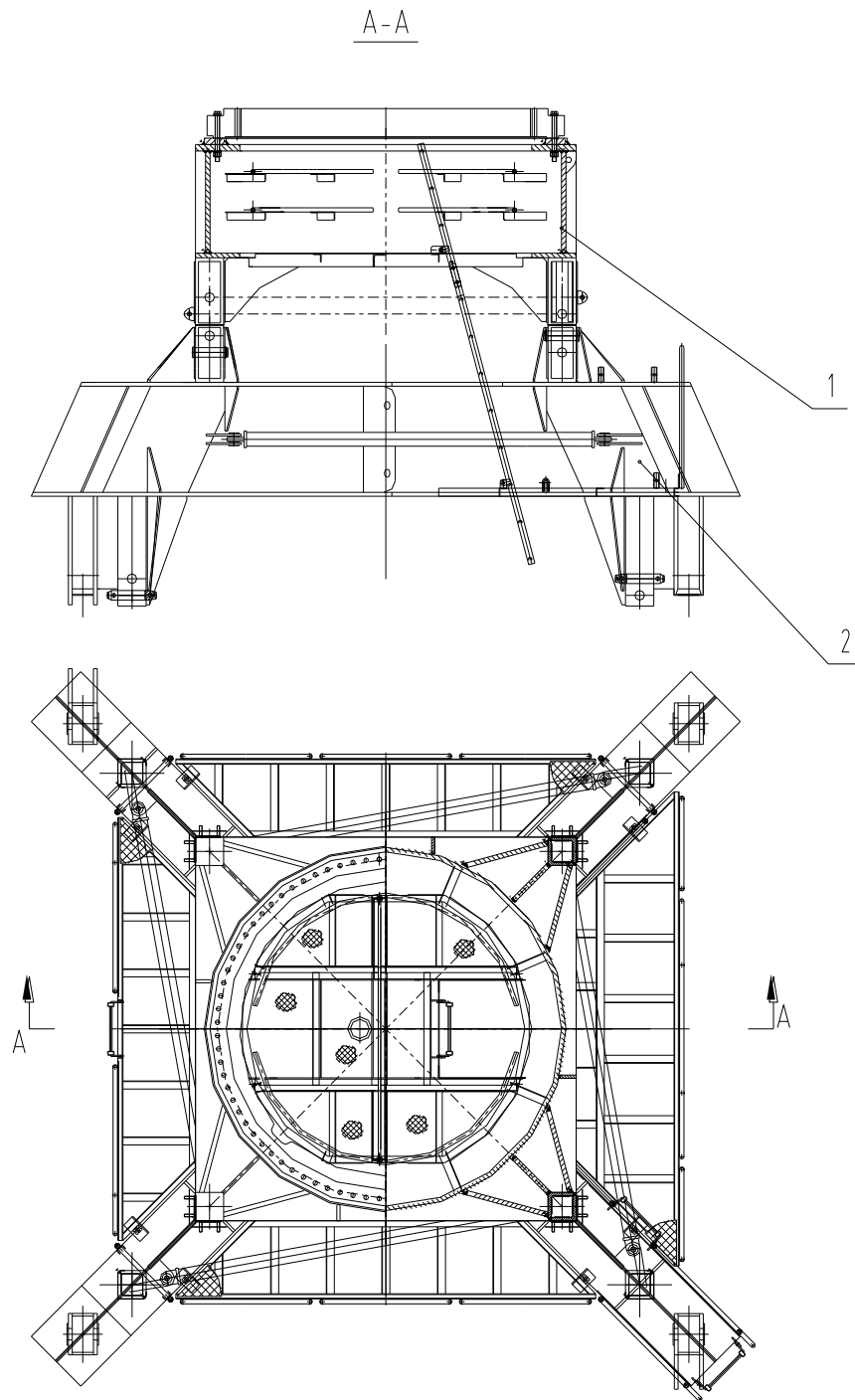


Fig. 7-34 000274010CT000000

Parts No.1 and No.2 are exploded in following drawings

Table 7-34 Spare parts list of Bottom Support (R1300-64Q.10A)

No.	Order No.	Code	Designation	Specification	Qty
1	000274010CT100000		Slewing support		1
2	000274010CT200000		Transition beam		1

7.7.1 Slewing Support

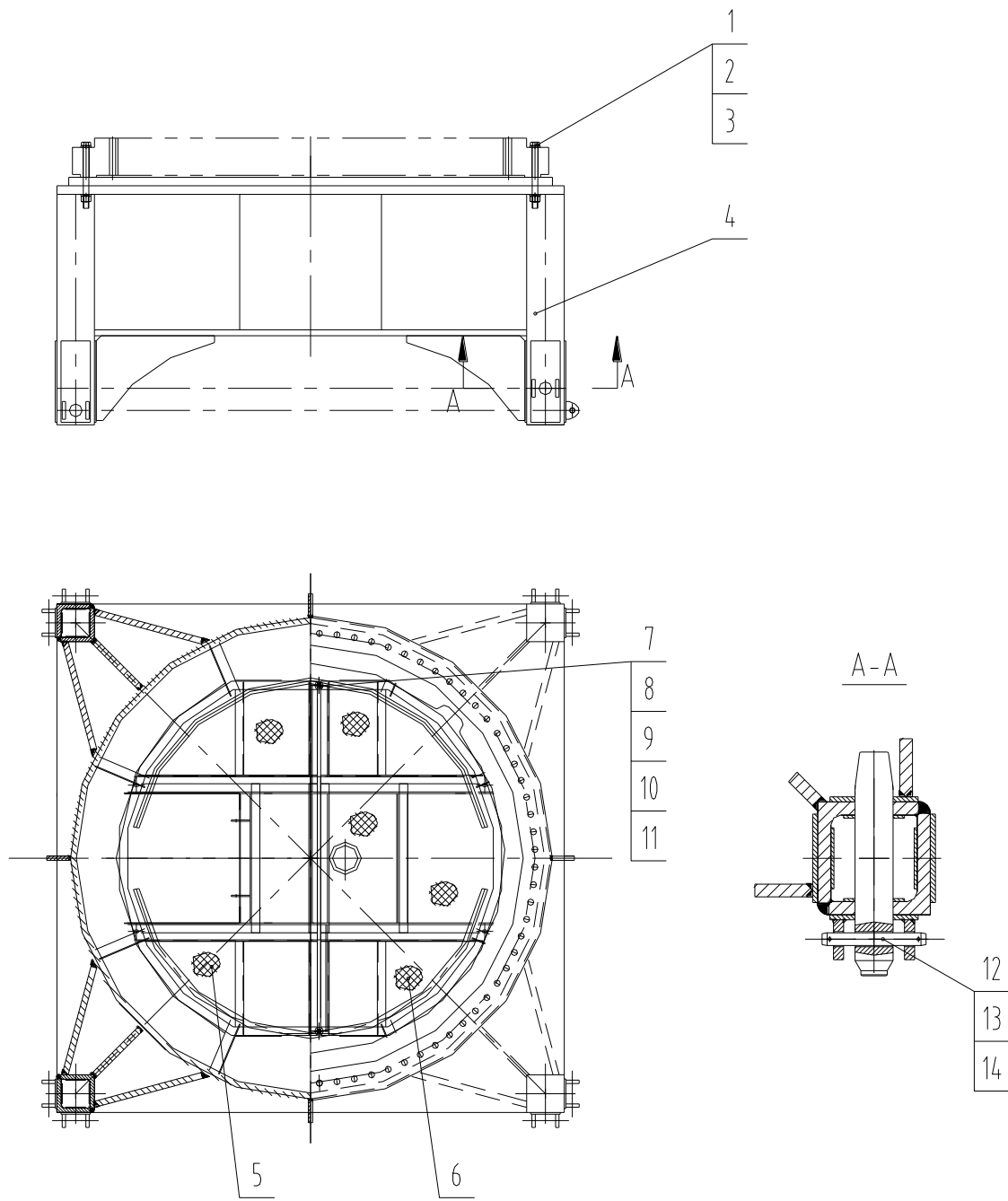


Fig. 7-35 000274010CT100000

Table 7-35 Spare parts list of Slewing Support

No.	Order No.	Code	Designation	Specification	Qty
1	1040006445	GB/T5785-2000	Bolt	M33×2×370-10.9	80
2	000241109AHV00002		Nut	M33×2	80
3	000241109AHV00003		Washer	33	160
4	000274010BT101000		Slewing support structure		1
5	000274010BT100100		Inner platform I		1
6	000274010AT000200		Inner platform II		1
7	1040000095	GB/T5783-2000	Bolt	M16×60-8.8	6
8	1040200110	GB/T6170-2000	Nut	M16-8	6
9	1040300065	GB/T93-1987	Washer	16	6
10	1040300052	GB/T97.1-2002	Washer	16-200HV	10
11	1040300247	GB/T96.1-2002	Washer	16-200HV	2
12	000274010BT100001		Pin	75	8
13	000209910A4051751	XZ03A-25×175/205	Pin	25×175	8
14	1040501339	DIN_11024	Spring pin	d1=6.3	16

7.7.2 Transition Beam

Without ladder

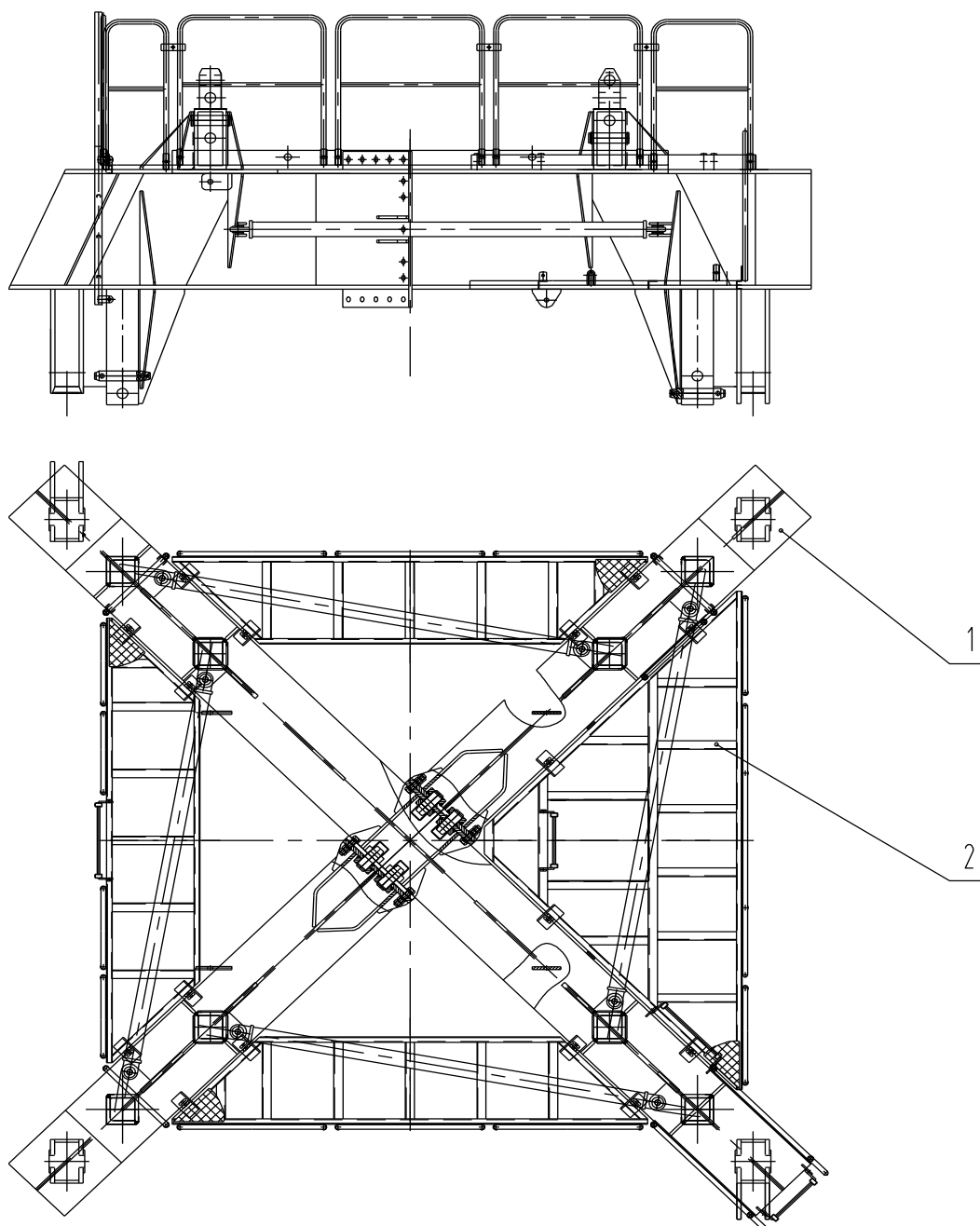


Fig. 7-36 000274010CT200000

Parts No.1 and No.2 are exploded in following drawings

Table 7-36 Spare parts list of Transition Beam

No.	Order No.	Code	Designation	Specification	Qty
1	000274010CT210000		Transition beam structure		1
2	000274010BT220000		Platform and ladder		1

7.7.2.1 Transition Beam Structure

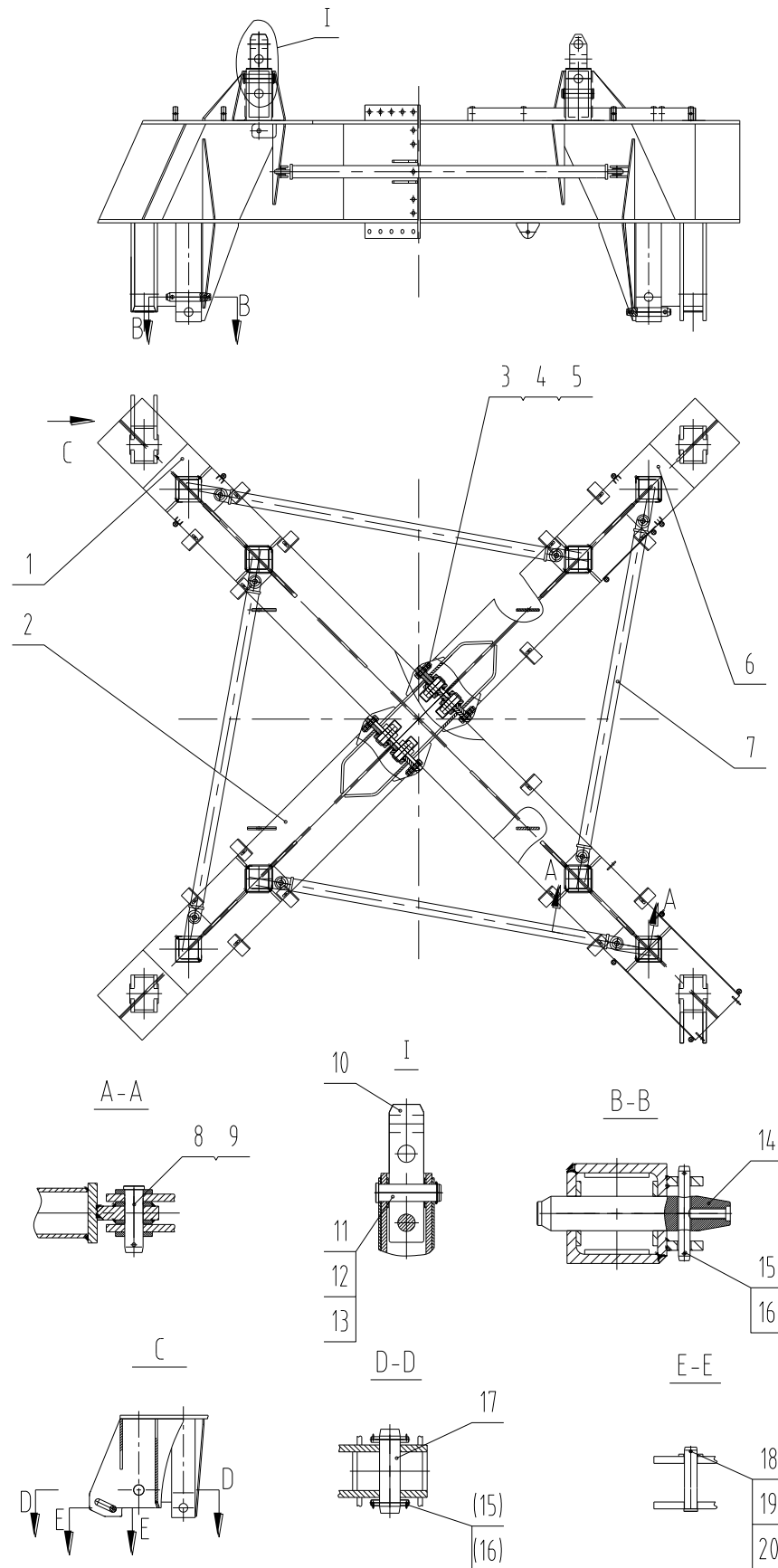


Fig. 7-37 000274010CT210000

Table 7-37 Spare parts list of Transition Beam Structure

No.	Order No.	Code	Designation	Specification	Qty
1	000274010BT215000		Whole beam		1
2	000274010BT216000		Half beam I		1
3	1040008459	GB/T5783-2000	Bolt	M33×150-10.9	40
4	1040201238	GB/T6170-2000	Nut	M33-10	80
5	1040301798	GB/T97.1-2002	Washer	33-300HV	80
6	000274010BT217000		Half beam II		1
7	000274010BT214000		Horizontal strut		4
8	000209910A1081201	XZ01C-40×120/145	Pin	40×120	8
9	1040500381	GB/T91-2000	Pin	8×71	8
10	000201113B0001106		Connector		4
11	000209021A9001701	XZ09E-75×249/280	Pin	75×249	8
12	000201213A0002101		Support ring		8
13	1040302979	ГОСТ13940-86	Concentric clasp	75	8
14	000209016A0400003		Pin	75×290	8
15	000209910A4051751	XZ03A-25×175/205	Pin	25×175	16
16	1040501339	DIN_11024	Spring pin	d1=6.3	32
17	000201110B0000005	XZ03C-90×275/360	Pin	90×275	4
18	000209910A1112501	XZ01C-55×250/290	Pin A		2
19	1040500244	GB/T91-2000	Pin	10×71	2
20	1040301865	GB/T97.1-2002	Washer	56-200HV	2

7.7.2.2 Platform and Ladder

Without ladder

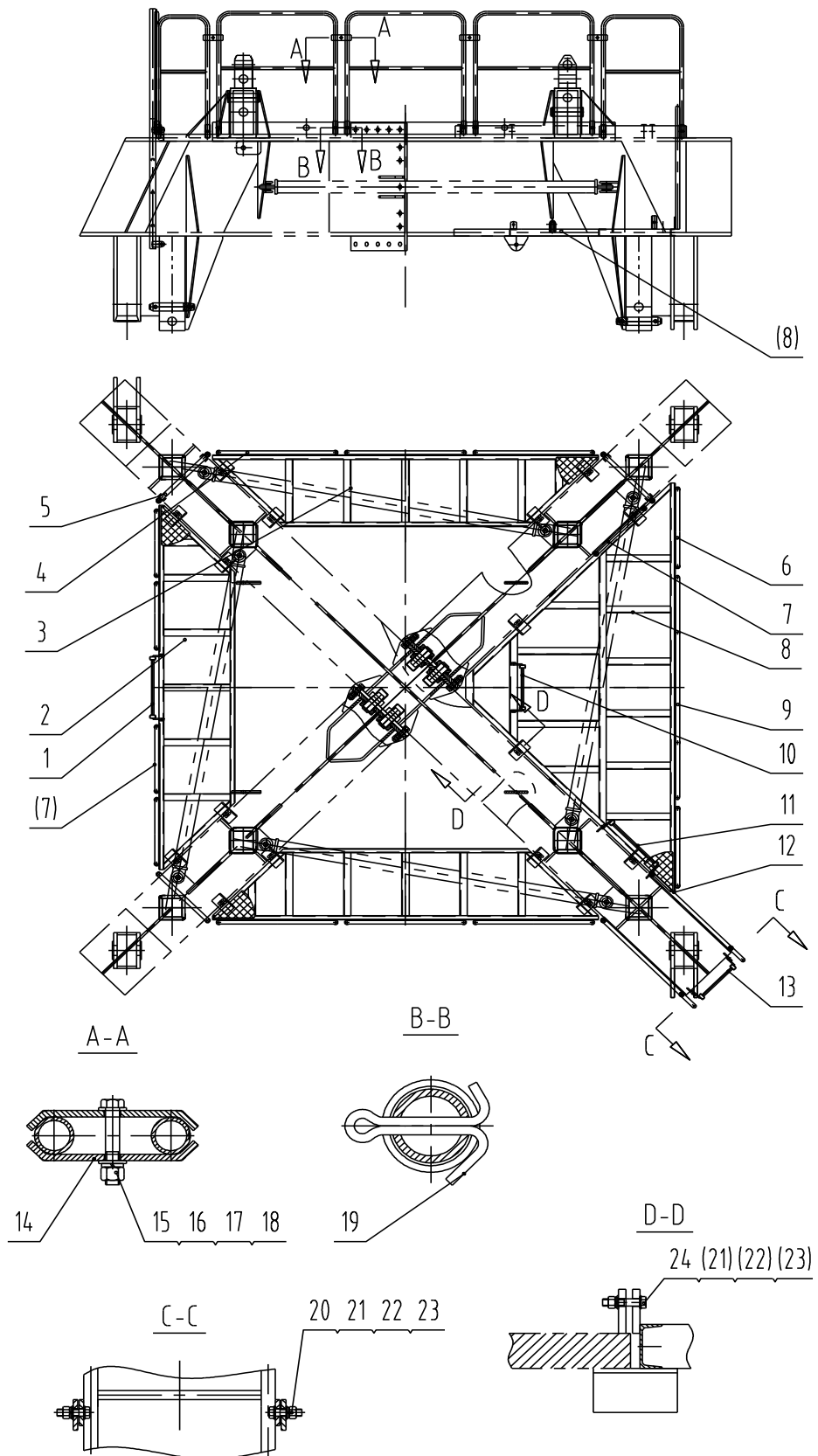


Fig. 7-38 000274010BT220000

Table 7-38 Spare parts list of Platform and Ladder

No.	Order No.	Code	Designation	Specification	Qty
1	000274010BT220200		Mounting-in side ladder		1
2	000274010BT224000		Cross beam platform D		1
3	000274010BT225000		Cross beam platform E		2
4	000209913D0010000	LGA1000C	Railing		6
5	000274010BT220300		Railing		3
6	000209913C0007000	LGA700B	Railing		2
7	000209913C0005800	LGA580B	Railing		5
8	000274010BT223000		Cross beam platform C		1
9	000209913C0020000	LGB2000B	Railing		1
10	000274010BT220400		Ladder		1
11	000274010BT220500		Cross beam ladder		1
12	000274010BT220600		Railing		2
13	000274010BT220700		Ladder and guard ring to climbing equipment		1
14	000209913A6000000	LGJB2	Railing splint	t2	28
15	1040000216	GB/T5783-2000	Bolt	M12×70-8.8	14
16	1040300041	GB/T97.1-2002	Washer	12-200HV	28
17	1040300054	GB/T93-1987	Washer	12	14
18	1040200096	GB/T6170-2000	Nut	M12-8	14
19	1040500222	GB/T91-2000	Pin	8×80	34
20	1040000095	GB/T5783-2000	Bolt	M16×60-8.8	16
21	1040300052	GB/T97.1-2002	Washer	16-200HV	64
22	1040300065	GB/T93-1987	Washer	16	32
23	1040200110	GB/T6170-2000	Nut	M16-8	32
24	1040000190	GB/T5783-2000	Bolt	M16×90-8.8	16

7.8 Trolley

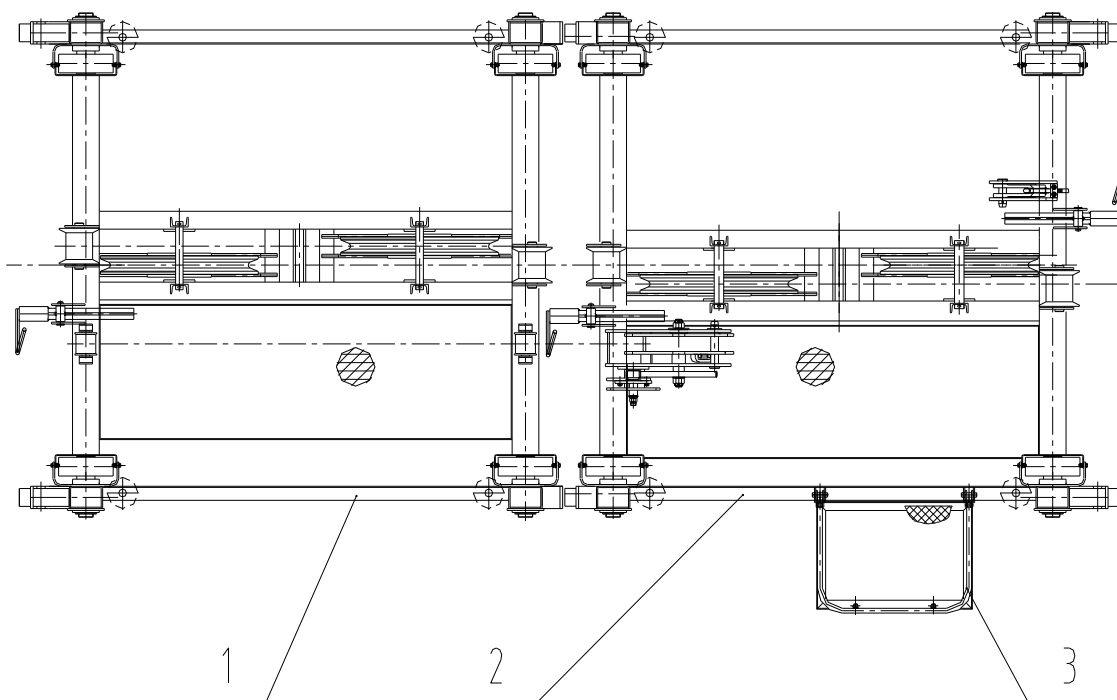


Fig. 7-39 000209722A0400000

Parts No.1 and No.2 are exploded in following drawings

Table 7-39 Spare parts list of Trolley (XC64D)

No.	Order No.	Code	Designation	Specification	Qty
1	000209722A0401000		Main trolley		1
2	000209722A0402000		Auxiliary trolley		1
3	000209901A0600000	DL6	Maintenance cage		1

7.8.1 Main Trolley

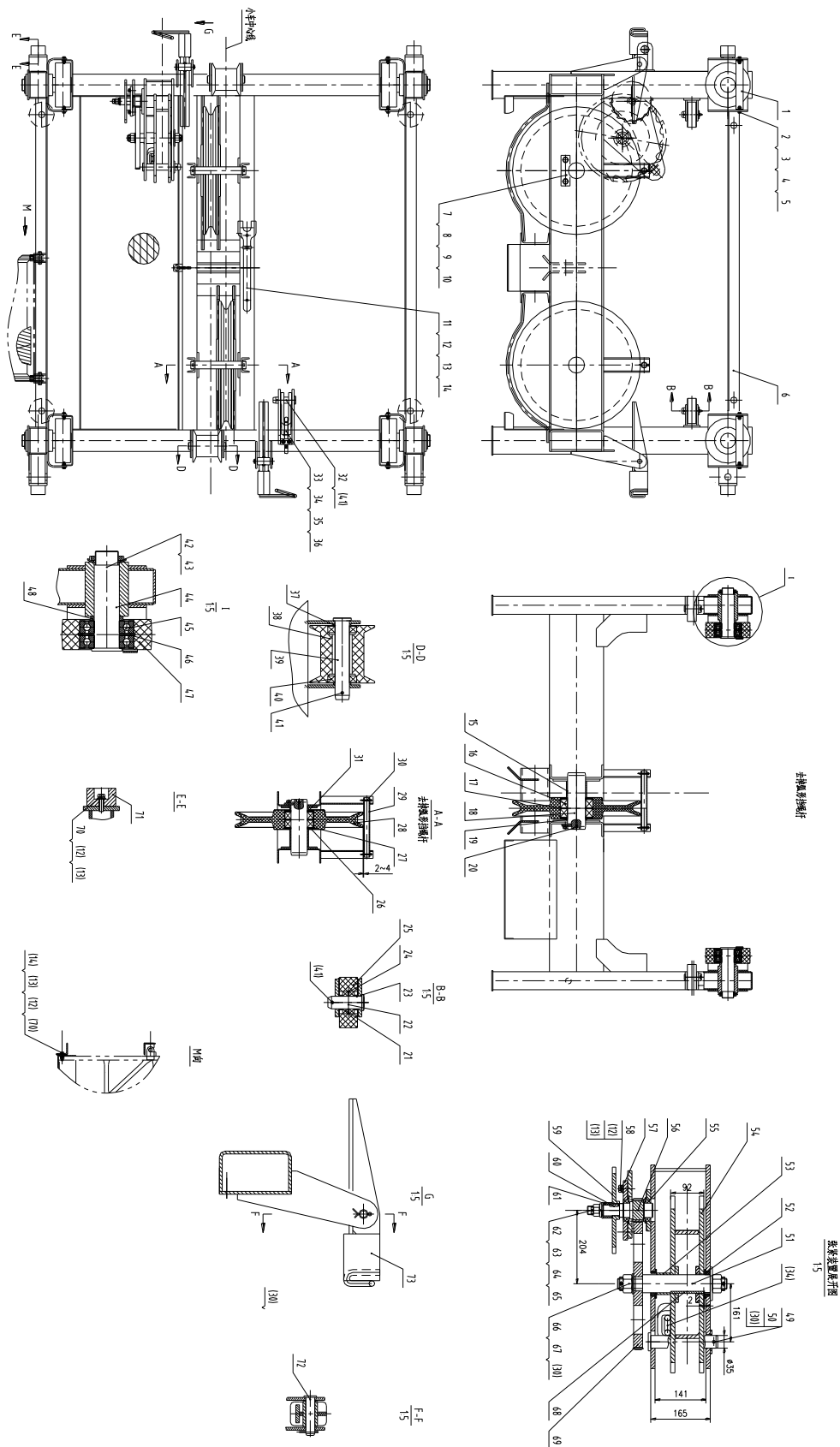


Fig. 7-40 000209722A0401000

Table 7-40 Spare parts list of Main Trolley

No.	Order No.	Code	Designation	Specification	Qty
1	000209722A0401001		Cover	t4	4
2	1040001680	GB/T5783-2000	Bolt	M10×30-8.8	8
3	1040300061	GB/T97.1-2002	Washer	10-200HV	16
4	1040300067	GB/T93-1987	Washer	10	8
5	1040200679	GB/T6170-2000	Nut	M10-8	8
6	000209722A0402100		Main trolley frame		1
7	000209722A0010001		Pallet	t10	2
8	1040000232	GB/T5783-2000	Bolt	M20×35-8.8	4
9	1040300038	GB/T93-1987	Washer	20	4
10	1040300106	GB/T97.1-2002	Washer	20-200HV	4
11	000209722A0015000		Tension wrench		1
12	1040300054	GB/T93-1987	Washer	12	12
13	1040300041	GB/T97.1-2002	Washer	12-200HV	14
14	1040200096	GB/T6170-2000	Nut	M12-8	4
15	000209712A0101001		Shaft sleeve B		2
16	1050200326	GB/T288-1994	Self-aligning roller bearing	22220C	4
17	000209711B0000116		Spacer		2
18	000209712A0101002		Pulley shaft		2
19	000209712A0200004		Shaft sleeve		2
20	1080000007	JB/T7940.1-1995	Oil cup	M10×1	2
21	1050200755	GB/T276-1994	Deep groove ball bearing	6007-Z	8
22	000209716A0010021		Pin		4
23	000209716A0010020		Shaft sleeve		8
24	1040300226	GB/T893.2-1986	Retainer ring	62	8
25	000209716A0010019		Side roller		4
26	000209711B0000118		Metal seal ring		4
27	1040300644	GB/T893.2-1986	Retainer ring	180	4
28	000209716A0010010		Pulley		2
29	000209723A0101004		Rope blocker	Φ33.7×3.2	2
30	1040500355	GB/T91-2000	Pin	6.3×56	10
31	000209711B0000117		Shaft sleeve C		4
32	000209903A0000661	XZ01C-34×95/125	Pin	34×95	1
33	1090100724	GB/T5973-2006	Wedge sleeve	16	1
34	1090100716	GB/T5973-2006	Wedge	16	2
35	1040500906	GB/T91-2000	Pin	3.2×32	1
36	1090100387	GB/T5976-1986	Rope clip	16KTH	1
37	000209716A0010016		Shaft sleeve		4
38	000209711B0000270		Riding wheel		2

No.	Order No.	Code	Designation	Specification	Qty
39	000209910A1072001	XZ01C-35×200/225	Pin	35×200	2
40	1050201563	GB/T276-2004	Deep groove ball bearing	6208-2RS1	4
41	1040500277	GB/T91-2000	Pin	8×56	8
42	1040200466	GB/T812-1988	Nut	M64×2	4
43	1040300418	GB/T858-1988	Washer	64	4
44	000209712A0101003		Roller shaft	Φ70-235/280	4
45	1050202165	GB/T276-2013	Deep groove ball bearing	6314-2RS	8
46	1040300680	GB/T893.2-1986	Retainer ring	150	8
47	000209711B0000119		Roller		4
48	000209722A0401002		Shaft sleeve		4
49	000209910A1071801	XZ01C-35×180/210	Pin	35×180	1
50	1040300090	GB/T97.1-2002	Washer	36-200HV	1
51	000209722A0402001		Tensioning wheel shaft		1
52	000209711B0000132		Shaft seat		2
53	000209722A0100005		Shaft sleeve		1
54	000209722A0100020		Tensioning wheel		1
55	000209711B0000144		Shaft seat		2
56	000209722A0100003		Gear shaft B		1
57	000209711B0000146		Pressing plate		1
58	1040000108	GB/T5783-2000	Bolt	M12×30-8.8	4
59	000209717B0030001		Ratchet wheel		1
60	000209717A0030002		Bond		1
61	000209722A0100004		Shaft sleeve		1
62	1040200326	GB/T6178-1986	Nut	M24-8	1
63	1040300050	GB/T97.1-2002	Washer	24-200HV	1
64	1040500046	GB/T91-2000	Pin	4×36	1
65	1040300049	GB/T93-1987	Washer	24	1
66	1040300074	GB/T97.1-2002	Washer	30-200HV	2
67	1040200215	GB/T6178-1986	Nut	M30-8	2
68	000209722A0100002		Bond		1
69	000209711B0000147		Gear		1
70	1040000101	GB/T5783-2000	Bolt	M12×40-8.8	6
71	000209704A1200001		Buffer		4
72	000200211CF001300	XZ01A-25×105/130	Pin	25×105	2
73	000209722A0401010		Safety brake		2

7.8.2 Auxiliary Trolley

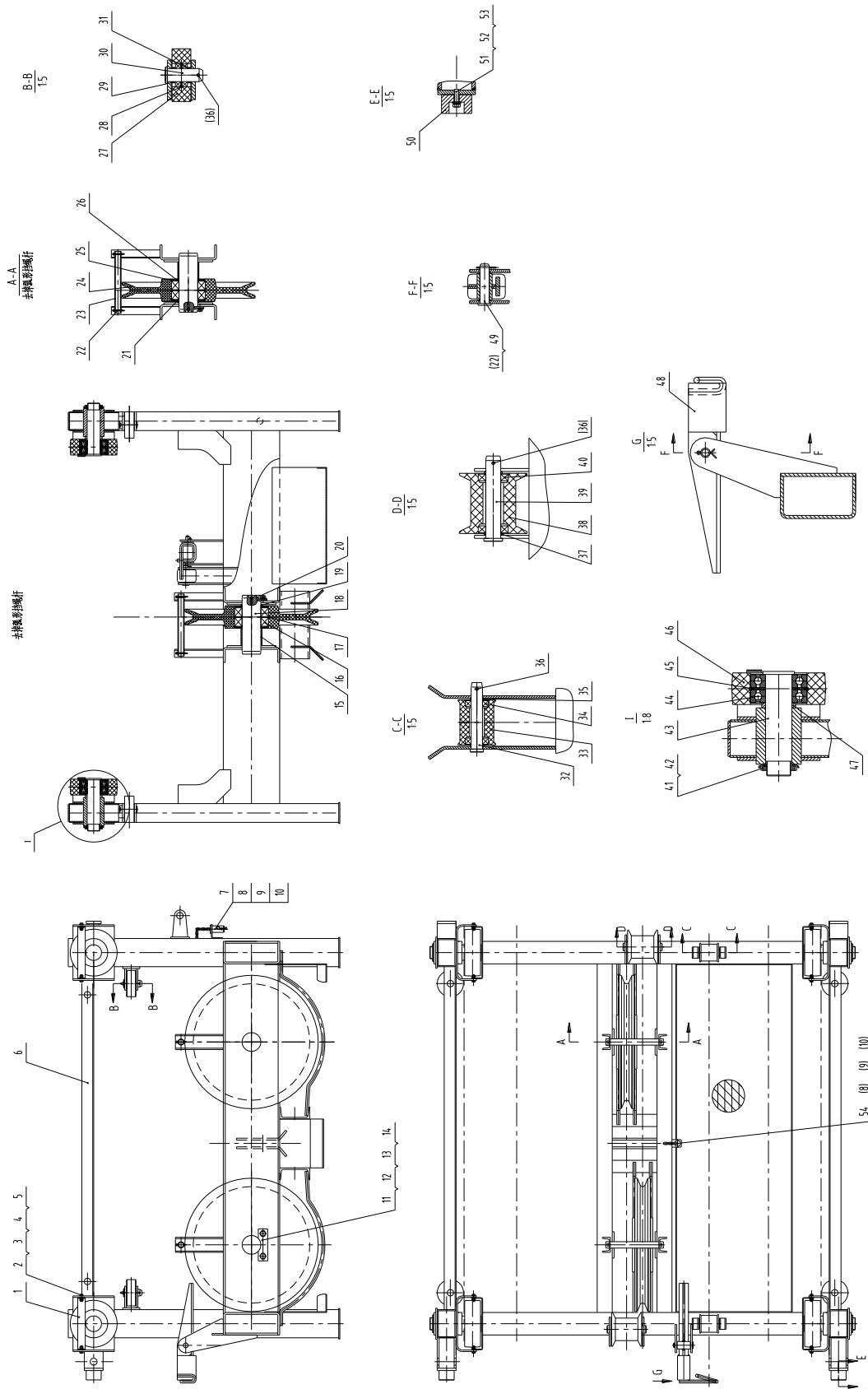


Fig. 7-41 000209722A0401000

Table 7-41 Spare parts list of Auxiliary Trolley

No.	Order No.	Code	Designation	Specification	Qty
1	000209722A0401001		Cover	t4	4
2	1040001680	GB/T5783-2000	Bolt	M1030-8.8	8
3	1040300061	GB/T97.1-2002	Washer	10-200HV	16
4	1040300067	GB/T93-1987	Washer	10	8
5	1040200679	GB/T6170-2000	Nut	M10-8	8
6	000209722A0401100		Auxiliary trolley frame		1
7	000209709C0001700	XZ01C-3560/90	Pin	3560	2
8	000209720A0301001		Pin		3
9	000209709C0001400		Spring		3
10	1090100353	JB/T8108.2-1999	Chain	d4-L400	3
11	000209722A0010001		Shaft hold	t10	2
12	1040000232	GB/T5783-2000	Bolt	M2035-8.8	4
13	1040300106	GB/T97.1-2002	Washer	20-200HV	4
14	1040300038	GB/T93-1987	Washer	20	4
15	000209712A0101001		Shaft sleeve B		2
16	1050200326	GB/T288-1994	Bearing	22220C	4
17	000209711B0000116		Washer		2
18	000209712A0101002		Pin		2
19	000209712A0200004		Shaft sleeve		2
20	1080000007	JB/T7940.1-1995	oil cup	M101	2
21	000209711B0000117		Shaft sleeve C		4
22	1040500355	GB/T91-2000	Spring	6.356	10
23	000209723A0101004		Rope resist shaft	33.73.2	2
24	000209716A0010010		Pulley		2
25	1040300644	GB/T893.2-1986	Washer	180	4
26	000209711B0000118		Seal ring		4
27	000209716A0010019		Side sheave		4
28	1040300226	GB/T893.2-1986	Washer	62	8
29	000209716A0010020		Shaft sleeve		8
30	000209716A0010021		Pin		4
31	1050200755	GB/T276-1994	Bearing	6007-Z	8
32	000209910A1061601	XZ01B-30160/185	Pin	30160	2
33	000209721F0101008		Roll		2
34	1050201944	GB/T276-2013	Bearing	6206-2RS	4
35	000209721F0101003		Shaft sleeve		4
36	1040500277	GB/T91-2000	Spring	856	4
37	000209716A0010016		Shaft sleeve		4
38	000209711B0000270		Riding wheel		2
39	000209910A1072001	XZ01C-35200/225	Pin	35200	2

No.	Order No.	Code	Designation	Specification	Qty
40	1050201563	GB/T276-2004	Bearing	6208-2RS1	4
41	1040200466	GB/T812-1988	Nut	M642	4
42	1040300418	GB/T858-1988	Washer	64	4
43	000209712A0101003		Roll shaft	70-235/280	4
44	1050202165	GB/T276-2013	Bearing	6314-2RS	8
45	1040300680	GB/T893.2-1986	Washer	150	8
46	000209711B0000119		Side roll		4
47	000209722A0401002		Shaft sleeve		4
48	000209722A0401010		Safety bar		1
49	000200211CF001300	XZ01A-25105/130	Pin	25105	2
50	000209704A1200001		Buffer		2
51	1040000101	GB/T5783-2000	Bolt	M1240-8.8	2
52	1040300054	GB/T93-1987	Washer	12	2
53	1040300041	GB/T97.1-2002	Washer	12-200HV	2
54	000209709C0001500		Pin		1

7.9 Hook

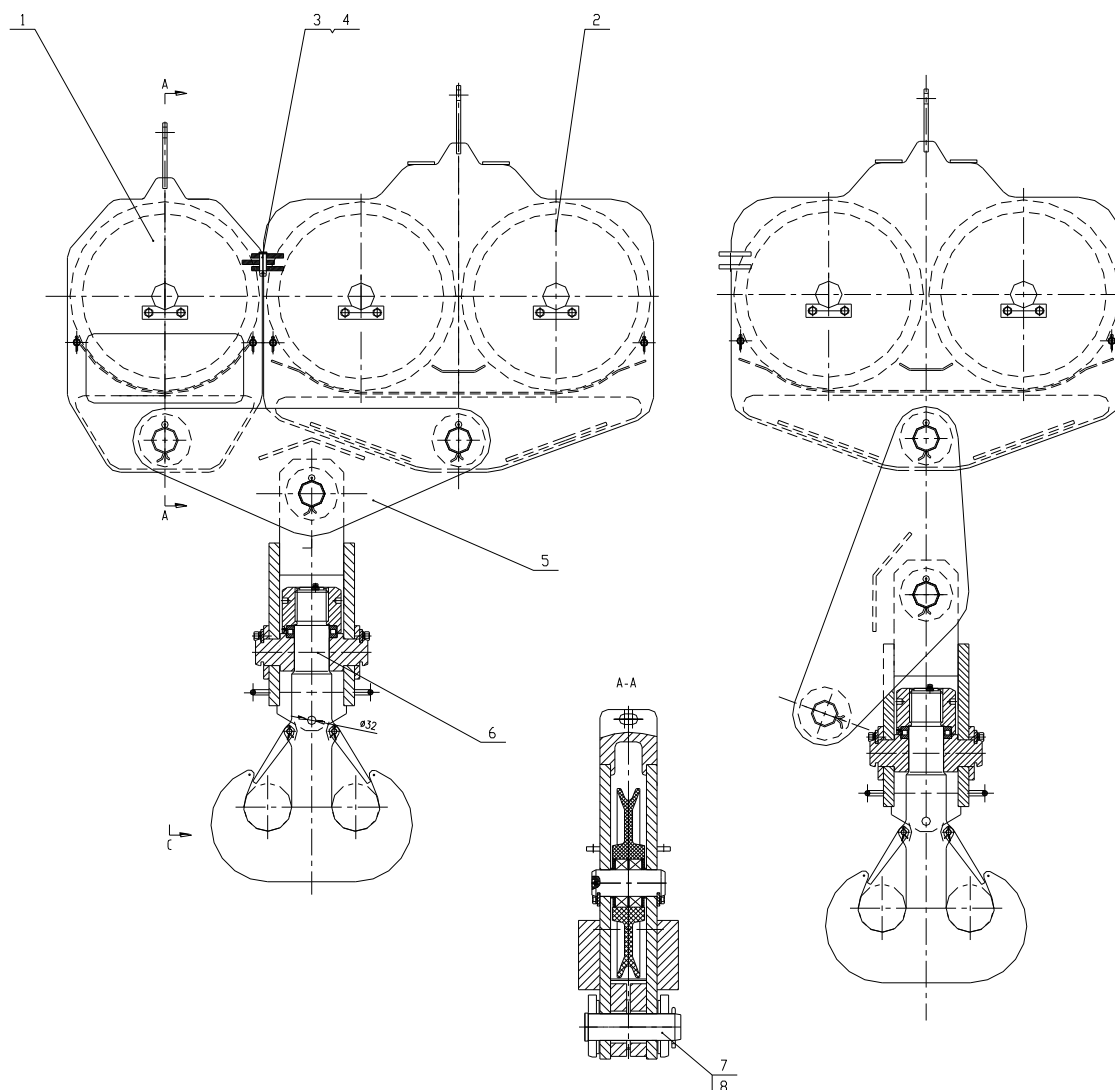


Fig. 7-42 000209620A0400000

Parts No.1, No.2, No.5 and No.6 are exploded in following drawings

Table 7-42 Spare parts list of Hook (DG64D)

No.	Order No.	Code	Designation	Specification	Qty
1	000209620A0401000		Auxiliary hook		1
2	000209620A0402000		Main Hook		1
3	000209910A1050701	XZ01B-25×70/90	Pin	25×70	2
4	1040500216	GB/T91-2000	Pin	6.3×50	2
5	000209620A0403000		Hook beam		1
6	000209620A0404000		Load hook		1
7	000209612E0000001	XZ01E-100×325/365	Pin		3
8	1040500965	GB/T91-2000	Pin	13×110	3

7.9.1 Main Hook

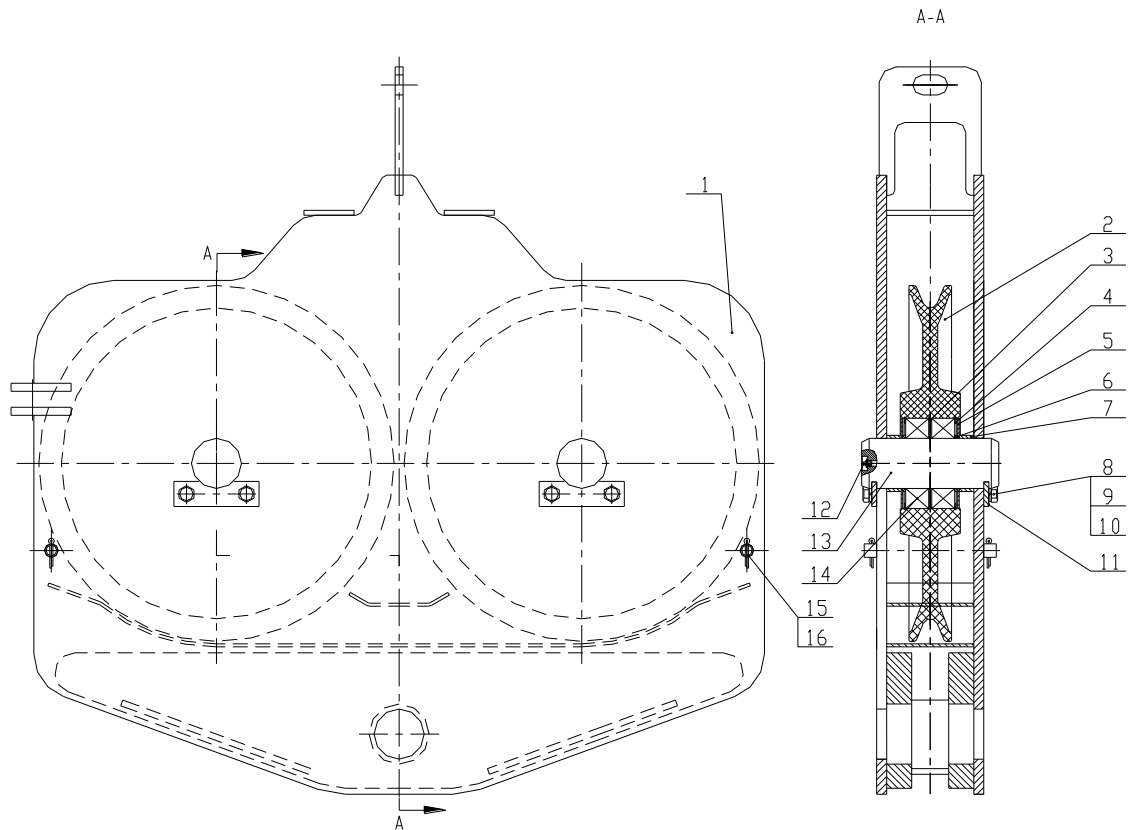


Fig. 7-43 000209620A0402000

Table 7-43 Spare parts list of Main Hook

No.	Order No.	Code	Designation	Specification	Qty
1	000209620A0402100		Main hook frame		1
2	000209716A0010010		Pulley		2
3	000209711B0000116		Sleeve		2
4	1040300644	GB/T893.2-1986	Check ring	180	4
5	000209711B0000118		Metal seal ring		4
6	000209711B0000117		Sleeve C		4
7	000209612E0002001		Sleeve		4
8	1040000232	GB/T5783-2000	Bolt	M2035-8.8	4
9	1040300038	GB/T93-1987	Washer	20	4
10	1040300106	GB/T97.1-2002	Washer	20-200HV	4
11	000209612D0001001		Damper	t10	4
12	1080000007	JB/T7940.1-1995	Oil cup	M101	2
13	000209612E0001002		Pulley shaft		2
14	1050200326	GB/T288-1994	Bearing	22220C	4
15	000209612E0001003		Rope blocker	26.92.8	2
16	1040500216	GB/T91-2000	Split pin	6.350	4

7.9.2 Auxiliary Hook

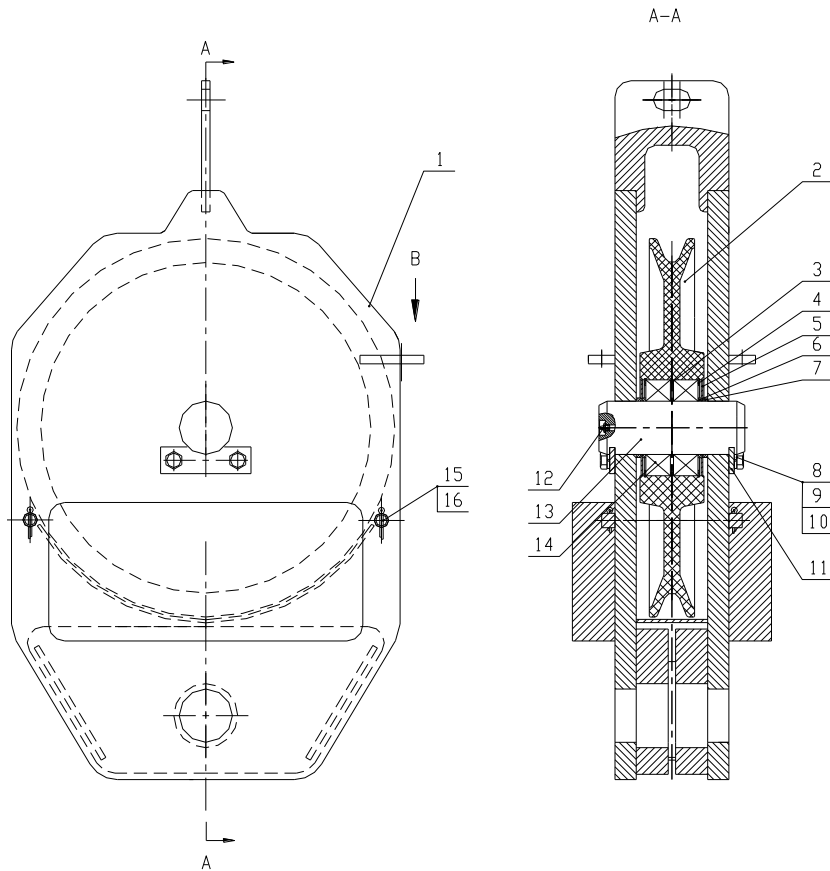


Fig. 7-44 000209620A0401000

Table 7-44 Spare parts list of Auxiliary Hook

No.	Order No.	Code	Designation	Specification	Qty
1	000209620A0401100		Plate		1
2	000209716A0010010		Pulley		1
3	000209711B0000116		Sleeve		1
4	1040300644	GB/T893.2-1986	Check ring	180	2
5	000209711B0000118		Metal seal ring		2
6	000209711B0000117		Shaft sleeve C		2
7	000209612E0001001		Shaft sleeve		2
8	1040000232	GB/T5783-2000	Bolt	M2035-8.8	4
9	1040300038	GB/T93-1987	Washer	20	2
10	1040300106	GB/T97.1-2002	Washer	20-200HV	2
11	000209612D0001001		Damper	t10	2
12	1080000007	JB/T7940.1-1995	Oil cup	M101	1
13	000209612E0001002		Pulley shaft		1
14	1050200326	GB/T288-1994	Bearing	22220C	2
15	000209612E0001003		Rope blocker	26.92.8	2
16	1040500216	GB/T91-2000	Split pin	6.350	4

7.9.3 Hook Beam

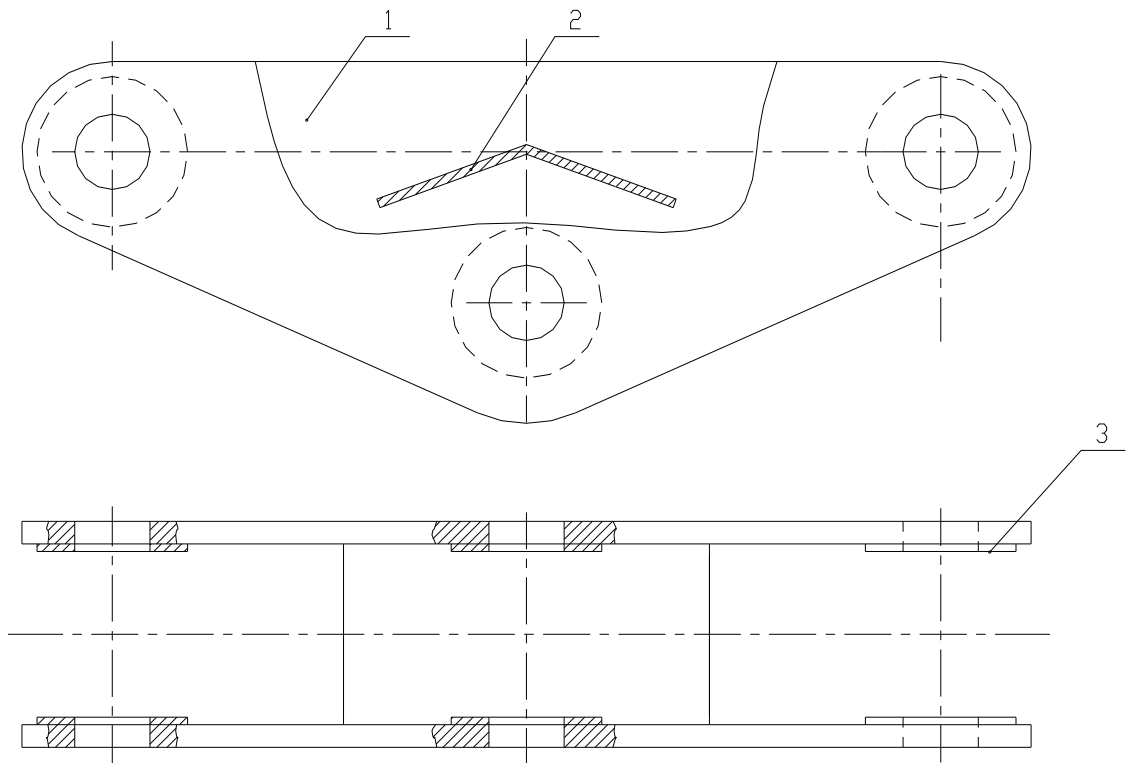


Fig. 7-45 000209620A0403000

Table7-45 Spare parts list of Hook Beam

No.	Order No.	Code	Designation	Specification	Qty
1	000209620A0403001		Bent plate	t30	2
2	000209620A0403002		Rib plate	t12	1
3	000209620A0403003		Flitch	t10	6

7.9.4 Load Hook

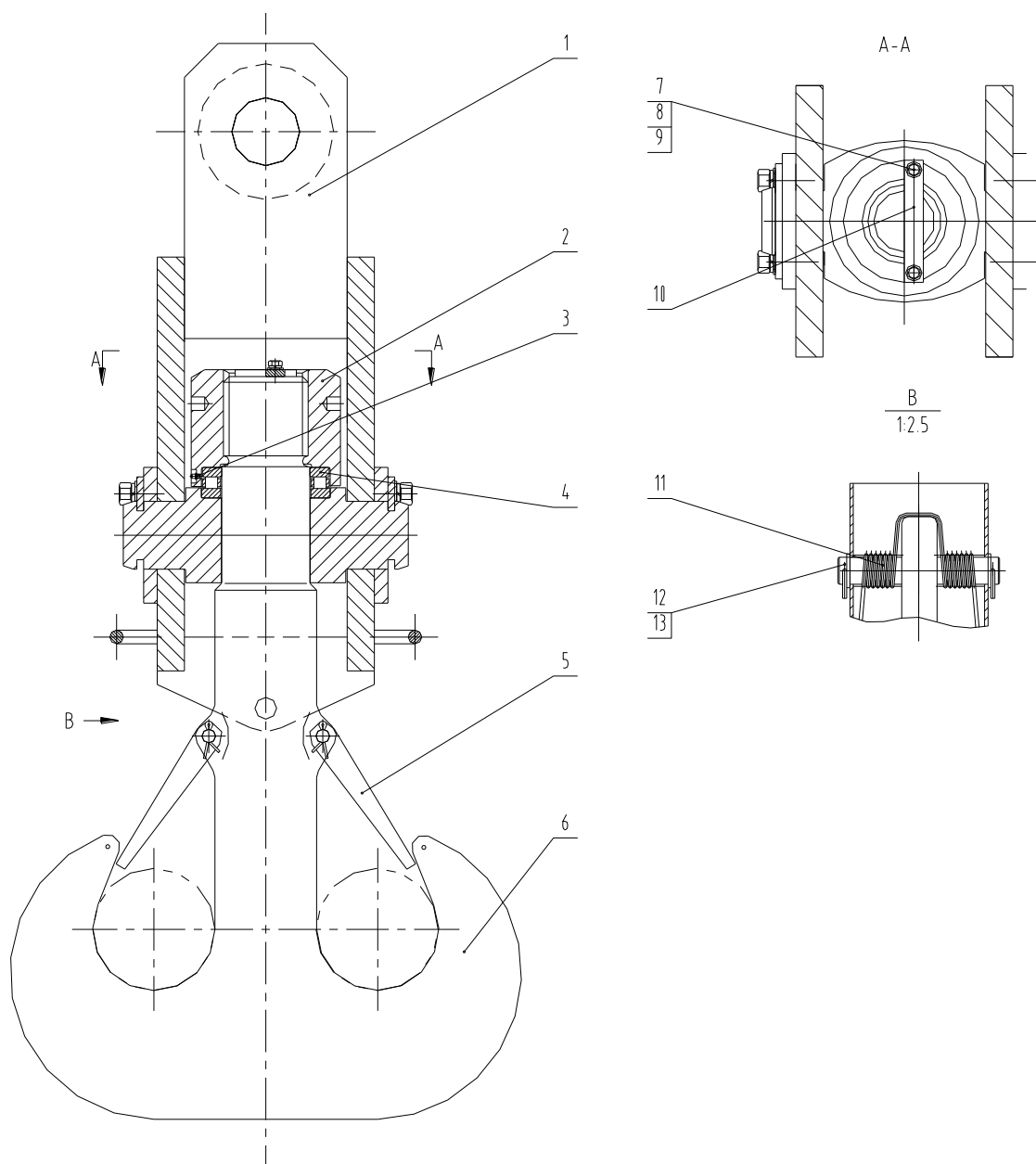
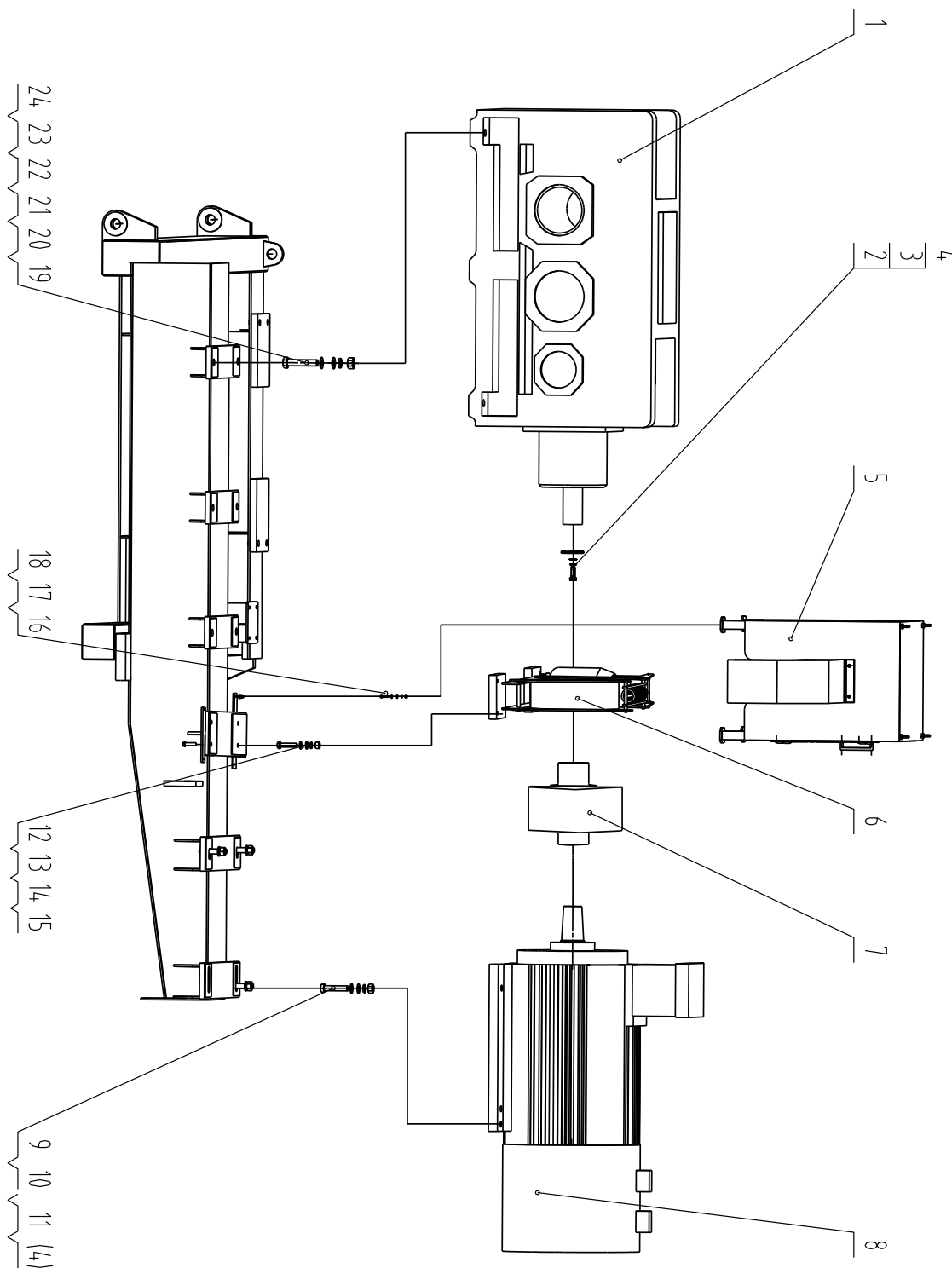


Fig. 7-46 000209620A0404000

Table7-46 Spare parts list of Load Hook

No.	Order No.	Code	Designation	Specification	Qty
1	000209620A0404100		Hook pallet		1
2	000209620A0003002		Hook nut		1
3	10800000005	JB/T7940.1-1995	Oil cup	M6×1	1
4	1050200435	GB/T4663-1994	Thrust cylinder roller bearing	81226	1
5	000209613A0055000		Hook blocker		2
6	000209620A0003001		Hook body		1
7	1040000108	GB/T5783-2000	Bolt	M12×30-8.8	2
8	1040300054	GB/T93-1987	Spring washer	12	2
9	1040300041	GB/T97.1-2002	Washer	12-200HV	2
10	000209611A0103003		Locking plate	t10	1
11	000209611B0000066		Spring		4
12	000209611B0000067		Pin		2
13	1040500253	GB/T91-2000	Pin	5×32	4

7.10 Hoisting Mechanism



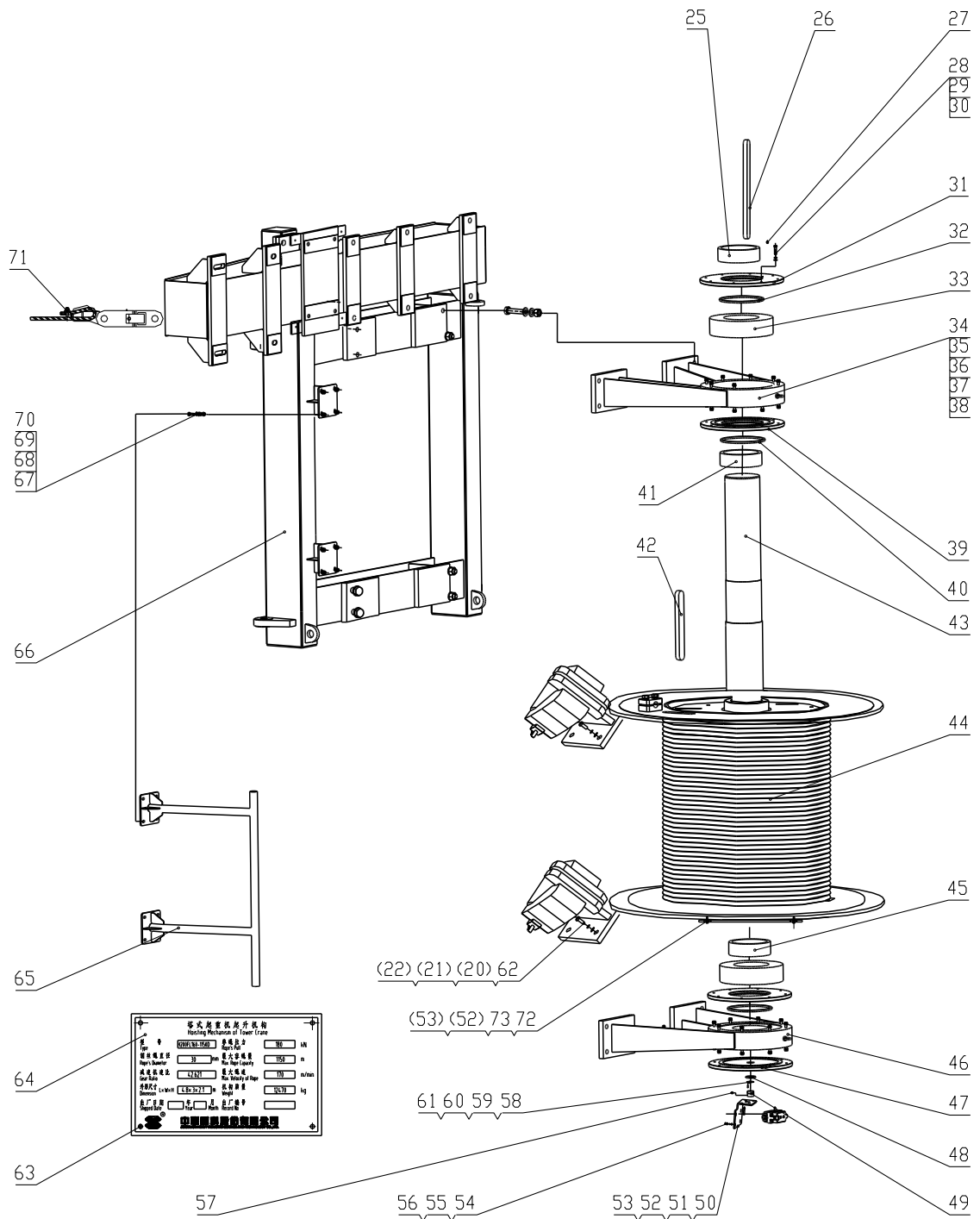


Fig. 7-47 000209195A1550000

Part No.7 is exploded in following drawing

Table 7-47 Spare parts list of Hoisting Mechanism (H200FL160-1150D)

No.	Order No.	Code	Designation	Specification	Qty
1	1030203126	MB3H150HB45BT	Reducer		1
2	000209196A8800001		Washer		1
3	1040000551	GB/T5783-2000	Bolt	M24×50-8.8	1
4	1040300049	GB/T93-1987	Spring washer	24	5
5	000209195A8101000		Brake cover		1
6	1039905411	YWZ501-500/300-II A-WC.RL.HL	Brake	380V,50Hz	1
7	000209944A0000570	MLL12-I-500-ZA110×167(25)/JA100×167(28)	Coupling		1
8	1020005145	TCA355L-8	Electromotor	200kW, 380V, 45Hz	1
9	1040002339	GB/T5783-2000	Bolt	M24×150-8.8	4
10	1040200102	GB/T6170-2000	Nut	M24-8	4
11	1040300050	GB/T97.1-2002	Washer	24-200HV	8
12	1040000089	GB/T5782-2000	Bolt	M20×80-8.8	4
13	1040200097	GB/T6170-2000	Nut	M20-8	4
14	1040300106	GB/T97.1-2002	Washer	20-200HV	4
15	1040300038	GB/T93-1987	Spring washer	20	4
16	1040000116	GB/T5783-2000	Bolt	M10×20-8.8	4
17	1040302271	GB/T93-1987	Washer	10	4
18	1040300764	GB/T96-1985	Washer	10-200HV	4
19	1040003313	GB/T5782-2000	Bolt	M36×160-8.8	6
20	1040200276	GB/T6170-2000	Nut	M36-8	14
21	1040300090	GB/T97.1-2002	Washer	36-200HV	28
22	1040300261	GB/T93-1987	Spring washer	36	14
23	000209171A0200010		Adjusting pad A	t1	1
24	000209171A0200011		Adjusting pad B	t1.5	1
25	000209196A2300002		Shaft sleeve B		1
26	1040600303	GB/T1096-2003	Bond	50×28×720	1
27	1080000249	JB/T7940.1-1995	Oil cup 90°	M10×1	3
28	1040101055	GB/T70.1-2008	Screw	M12×45-8.8	24
29	1040300041	GB/T97.1-2002	Washer	12-200HV	24
30	1040300054	GB/T93-1987	Spring Washer	12	24
31	000209196A2300003		Bearing-end Cover A I	t25	2
32	000209944A0600030	ZQ280	Felt collar 280		2
33	1050200461	GB/T288-1994	Self-aligning roller bearing	23148	2
34	000209196A2303000		Bearing seat A		1

No.	Order No.	Code	Designation	Specification	Qty
35	1040002359	GB/T5782-2000	Bolt	M30×130-8.8	8
36	1040200197	GB/T6170-2000	Nut	M30-8	8
37	1040300010	GB/T93-1987	Spring washer	30	8
38	1040300074	GB/T97.1-2002	Washer	30-200HV	16
39	000209196A8800005		Bearing-end Cover A I		1
40	000209944A0600110	ZQ285	Felt collar 285		1
41	000209196A8800002		Shaft sleeve A		1
42	1040600510	GB/T1096-2003	Bond	56×32×600	1
43	000209195A1550001		Main shaft		1
44	000209195A1552000		Drum		1
45	000209195A1440002		Shaft sleeve		1
46	000209195A0601000		Bearing seat B		1
47	000209195A0600003		Bearing-end Cover B II	t25	1
48	000209195A5700002		Oil Seal		1
49	000209944A0200023	NLT-3	Nylon Sleeve		1
50	000209944A0400030	XWZJ-01	Limiter support	t5	1
51	1040000267	GB/T5783-2000	Bolt	M8×20-8.8	4
52	1040300066	GB/T97.1-2002	Washer	8-200HV	8
53	1040300063	GB/T93-1987	Spring washer	8	8
54	1040000151	GB/T5783-2000	Bolt	M5×12-8.8	4
55	1040300048	GB/T97.1-2002	Washer	5-200HV	4
56	1040300060	GB/T93-1987	Spring washer	5	4
57	1040500054	GB/T91-2000	Pin	4×40	1
58	000209195A6500003		Pulling pin		1
59	000209195A5700004		Pressing plate	t8	1
60	1040000107	GB/T5783-2000	Bolt	M6×20-8.8	2
61	1040300062	GB/T93-1987	Spring washer	6	2
62	1040002598	GB/T5782-2000	Bolt	M36×130-10.9	8
63	1040400058	GB/T827-1986	Rivet	2.5×8	4
64	000209195A1550009	H200FL160- 1150D-MP	Nameplate		1
65	000209195A1553000		Rope blocker		1
66	000209195A1551000		Underframe		1
67	1040000065	GB/T5783-2000	Bolt	M16×45-8.8	8
68	1040201382	GB/T6170-2000	Nut	M16-8	8

No.	Order No.	Code	Designation	Specification	Qty
69	1040300052	GB/T97.1-2002	Washer	16-200HV	16
70	1040300065	GB/T93-1987	Spring washer	16	8
71	1090100590	GB/T5976-1986	Rope clip	32KTH	1
72	000209944A0100010		Approach switch sensor disk		1
73	1040000110	GB/T5783-2000	Bolt	M8×35-8.8	4

7.10.1 Coupling

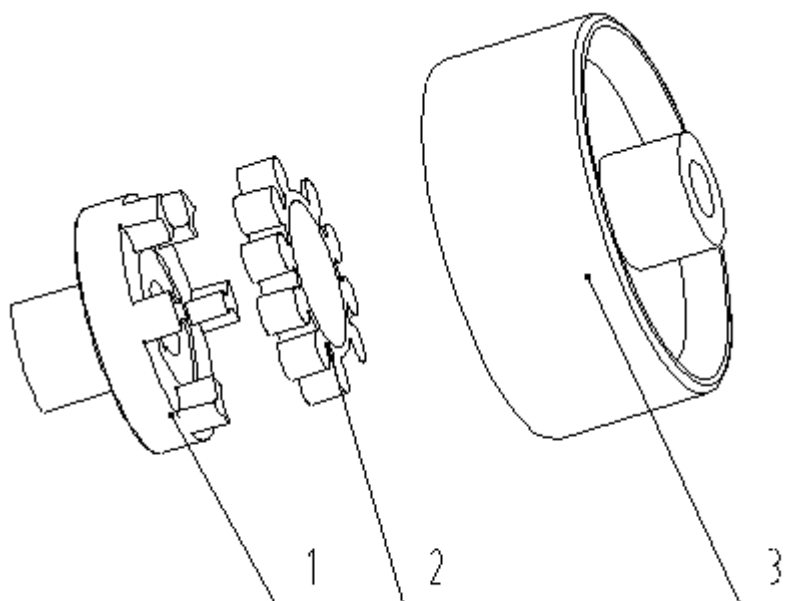


Fig. 7-48 000209944A0000930

Table 7-48 Spare parts list of Coupling

No.	Order No.	Code	Designation	Specification	Qty
1	000209944A0000572		Semi-coupling		1
2	000209944A0000262	MT12-b	Elastomer		1
3	000209944A0000571		Semi-coupling		1

7.11 Safety Brake Caliper

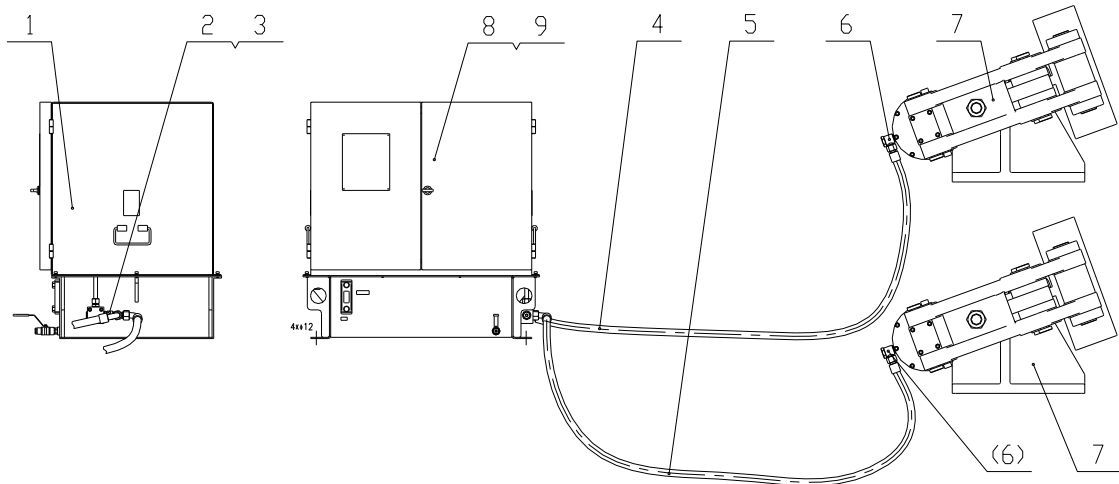


Fig. 7-49 000214024AT000000

Table 7-49 Spare parts list of Safety Brake Caliper (R1600-64W.24)

No.	Order No.	Code	Designation	Specification	Qty
1	1010002789	YZBS10-20/1A.CP	Pumping station		1
2	1140104945	GE15LMEDOMDA3C	Straight joint		1
3	1140107793	EL15LOMDA3C	Joint		1
4	1011402673	Q/ZLZK1010010-2018	Pipe	F481CACF151508-7500S	1
5	1140249247	Q/ZLZK1010010-2012	Pipe	F481CACF151508-3300S	1
6	1140104335	SWVE15LMOMDA3C	Hinge joint		2
7	1031700134	SBD240-D	Safety Brake		2
8	1019901224	VKAM15LCF	Cone-hole plug		2
9	1149800623	ROV15LCFX	Pipe-end plug		2

7.12 Trolley Mechanism

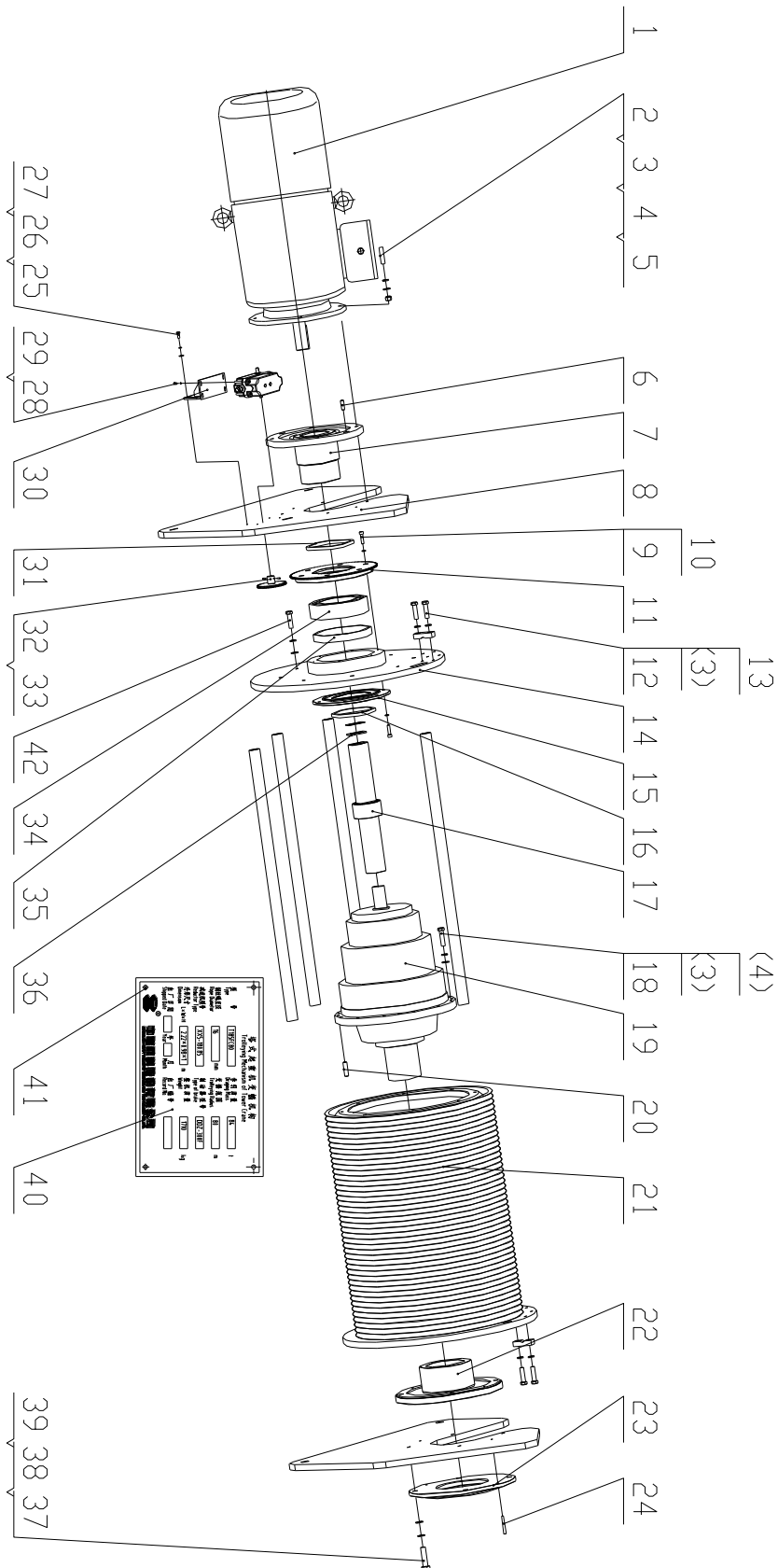


Fig. 7-50 000209370A1900000

Table 7-50 Spare parts list of Trolley Mechanism (T185FC80)

No.	Order No.	Code	Designation	Specification	Qty
1	1020000169	YVFE200L1-6B5-18.5kW	Electromotor		1
2	1040001503	GB/T899-1988	Studs	M16×70-8.8	4
3	1040300065	GB/T93-1987	Washer	16	36
4	1040300052	GB/T97.1-2002	Washer	16-200HV	24
5	1040200110	GB/T6170-2000	Nut	M16-8	4
6	1040500678	GB/T879.1-2000	Elastic cylindrical pin	12×45	2
7	000209333B0000110		Flange B		1
8	000209370A1900100		Support		1
9	1040100235	GB/T70.1-2000	Screw	M10×40-8.8	12
10	1040300067	GB/T93-1987	Washer	10	12
11	000209333B0000090		Hatch II		1
12	1040000177	GB/T5783-2000	Bolt	M16×55-8.8	12
13	000209370A1900001		Ballast	t18	6
14	000209370A1900002		Flange A		1
15	000209333B0000080		Hatch I		1
16	000209333B0000140		Felt collar 160		1
17	000209370A1900010		Coupling		1
18	1040000286	GB/T5783-2000	Bolt	M16×65-8.8	12
19	1030200664	XX5-180.85	Reducer		1
20	1040500644	GB/T879.1-2000	Pin	16×60	4
21	000209370A1900200		Drum		1
22	000209333B0000030		Connecting sleeve		1
23	000209333B0000020		End cover		1
24	1040500679	GB/T879.1-2000	Elastic cylindrical pin	12×75	2
25	1040000267	GB/T5783-2000	Bolt	M8×20-8.8	4
26	1040300063	GB/T93-1987	Washer	8	4
27	1040300066	GB/T97.1-2002	Washer	8-200HV	4
28	1040000151	GB/T5783-2000	Bolt	M5×12-8.8	4
29	1040300060	GB/T93-1987	Washer	5	4
30	000209333B0000600		Support		1
31	000209333B0000100		Felt collar 175		1
32	000209333B0000150		Small gear		1
33	1040000619	GB/T71-1985	Screw	M5×16-14H	2
34	1050200456	GB/T288-1994	Bearing	23032	1
35	000209333B0000130		Sleeve		1
36	000209333B0000120		Adjusting pad		1
37	1040000377	GB/T5783-2000	Bolt	M20×80-8.8	4

No.	Order No.	Code	Designation	Specification	Qty
38	1040301506	GB/T93-1987	Washer	20	4
39	1040300106	GB/T97.1-2002	Washer	20-200HV	4
40	000209370A1900003		Nameplate	t1	1
41	1040400058	GB/T827-1986	Rivet	2.5×8	4
42	1040000095	GB/T5783-2000	Bolt	M16×60-8.8	8

7.13 Slewing Mechanism

7.13.1 S185CA-350.275CD20/13B

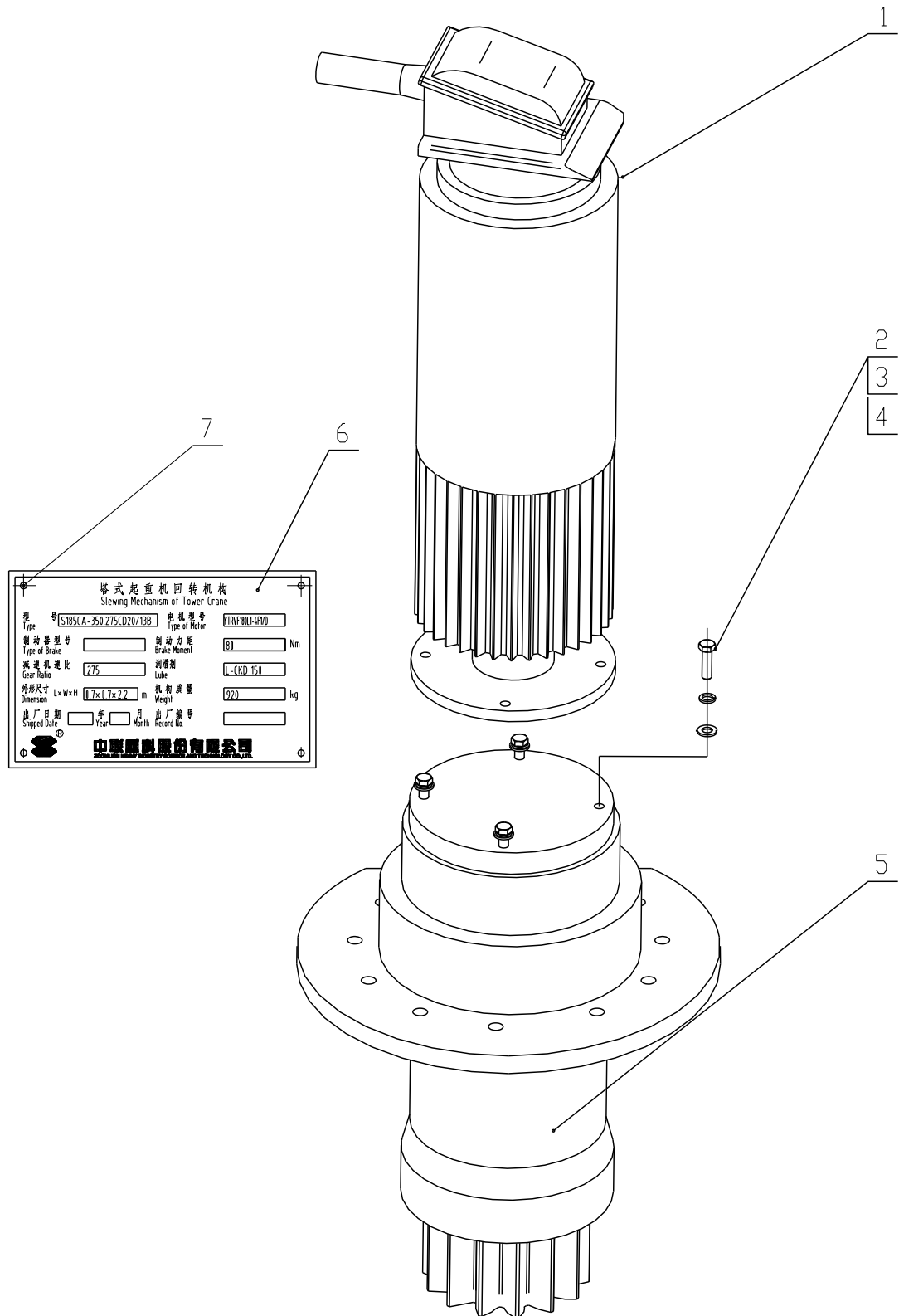


Fig. 7-51 000209289A1050000

Table 7-51 Spare part list of Slewing Mechanism (S75CA-130.195LB14/13A)

No.	Order No.	Code	Designation	Specification	Qty
1	1020005515	YTRVF180L1-4F1/D	Electric motor	18.5kW	1
2	1040000198	GB/T5783-2000	Bolt	M16×50-8.8	4
3	1040300065	GB/T93-1987	Washer	16	4
4	1040300052	GB/T97.1-2002	Washer	16-200HV	4
5	1030202901	XX5-350.275CD-20/13	Reducer		1
6	000209289A1050100		Nameplate		1
7	1040400045	GB/T827-1986	Rivet	2×5	4

7.13.2 S185CN-350.275CD20/13B

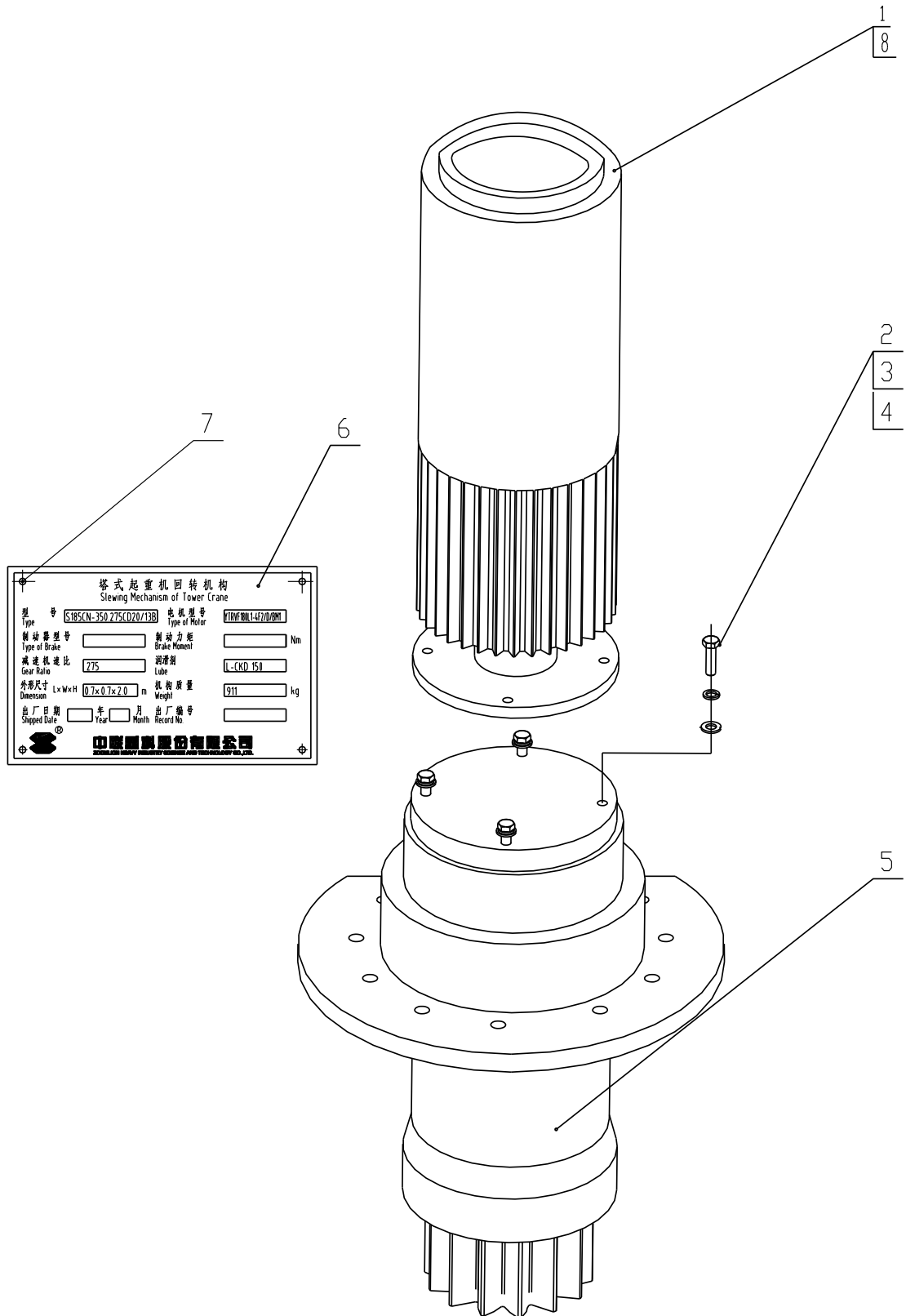
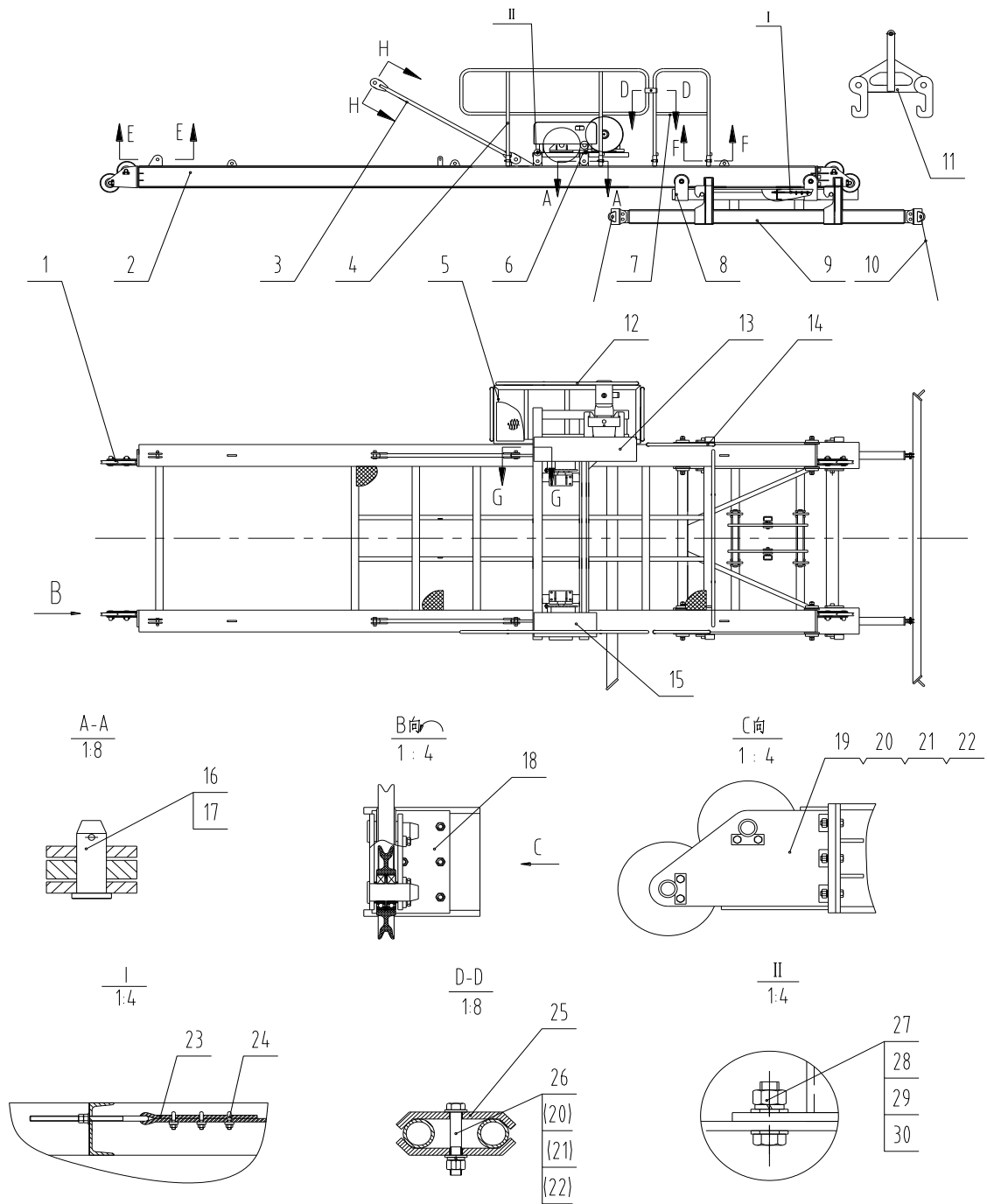


Fig. 7-52 000209289A1090000

Table 7-52 Spare part list of Slewing Mechanism (S185CN-350.275CD20/13B)

No.	Order No.	Code	Designation	Specification	Qty
1	1020005516	YTRVF180L1-4F2/D/BM1	Electromotor	18.5kW	1
2	1040000198	GB/T5783-2000	Bolt	M16×50-8.8	4
3	1040300065	GB/T93-1987	Spring washer	16	4
4	1040300052	GB/T97.1-2002	Washer	16-200HV	4
5	1030202901	XX5-350.275CD-20/13	Reducer		1
6	000209289A1090100		Nameplate		1
7	1040400045	GB/T827-1986	Rivet	2×5	4
8	1020202072	ECK58B(Nr:851249/10)	Encoder	1024PPR	1

7.14 Mounting Device



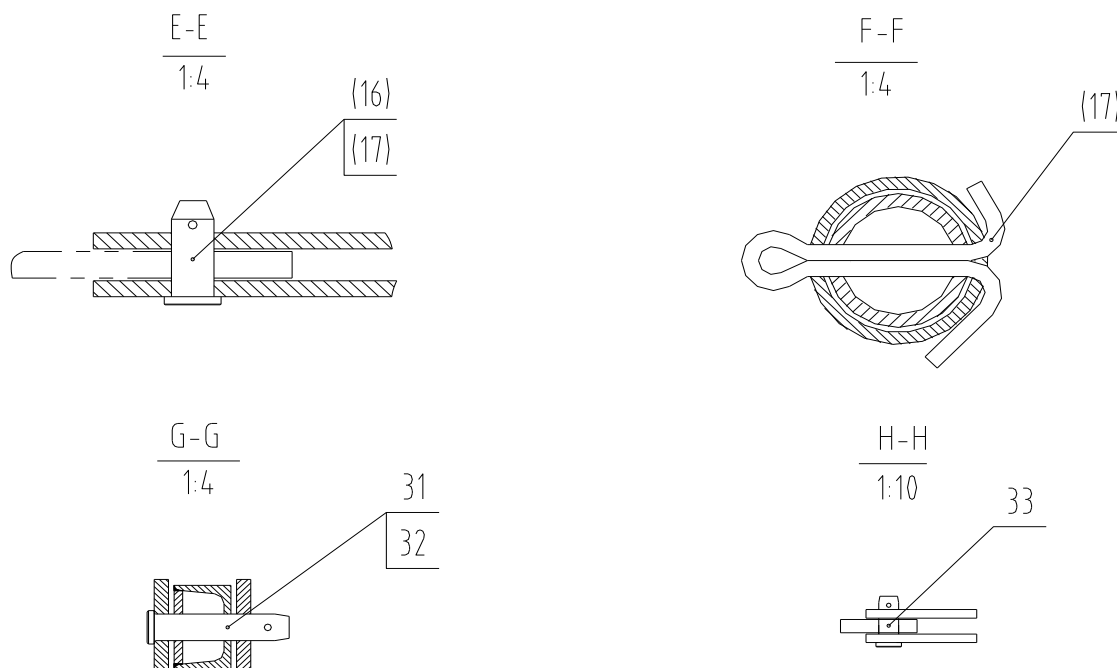


Fig. 7-53 000274019AT000000

Parts No.1, No.8 and No.9 are exploded in following drawings

Table 7-53 Spare parts list of Mounting Device (R1300-64Q.19)

No.	Order No.	Code	Designation	Specification	Qty
1	000201108B0000900		Pulley assembly		2
2	000274019AT010000		Mounting beam		1
3	000274019AT050000		Tie bar		2
4	000209913C0020000	LGB2000B	Railing		2
5	000274019AT020000		Platform		1
6	000274019AT030000		Hauling mechanism		1
7	000209913C0005800	LGA580B	Railing		3
8	000201108B0000100		Mounting trolley		1
9	000283019AR030000		Lifting Frame		1
10	000274019AT040000		Rigging		4
11	000201108B0000400		Mounting hook		1
12	000209913C0015000	LGC1500B	Railing		1
13	000262019BL020300		Dust cover I		1
14	000209913C0007000	LGA700B	Railing		1
15	000272019AT170000		Mounting mechanism cover II		1
16	000201108B0000001	XZ01C-30×60/90	Pin	30×60	6
17	1040500381	GB/T91-2000	Pin	8×71	24
18	000201108B0000600		Pulley assembly		2
19	1040005539	GB/T5783	Bolt	M12×50	24

No.	Order No.	Code	Designation	Specification	Qty
20	1040200096	GB/T6170-2000	Nut	M12-8	30
21	1040300054	GB/T93-1987	Washer	12	30
22	1040300041	GB/T97.1-2002	Washer	12-200HV	36
23	1090100080	GB/T8918-2006	Rope	6×19-9.3-1700-II-SZ	4
24	1090100081	GB/T5976-2006	Rope clip	10KTH	12
25	000209913A6000000	LGJB2	Railing splint	t2	12
26	1040000216	GB/T5783-2000	Bolt	M12×70-8.8	6
27	1040001680	GB/T5783-2000	Bolt	M10×30-8.8	8
28	1040300764	GB/T96-1985	Washer	10-200HV	8
29	1040300067	GB/T93-1987	Washer	10	16
30	1040201610	GB/T6170-2000	Nut	M10-8	8
31	000209910A1040801	XZ01B-20×80/100	Pin	20×80	4
32	1040500253	GB/T91-2000	Pin	5×32	4
33	000209910A1070701	XZ01C-35×70/95	Pin	35×70	4

7.14.1 Mounting Trolley

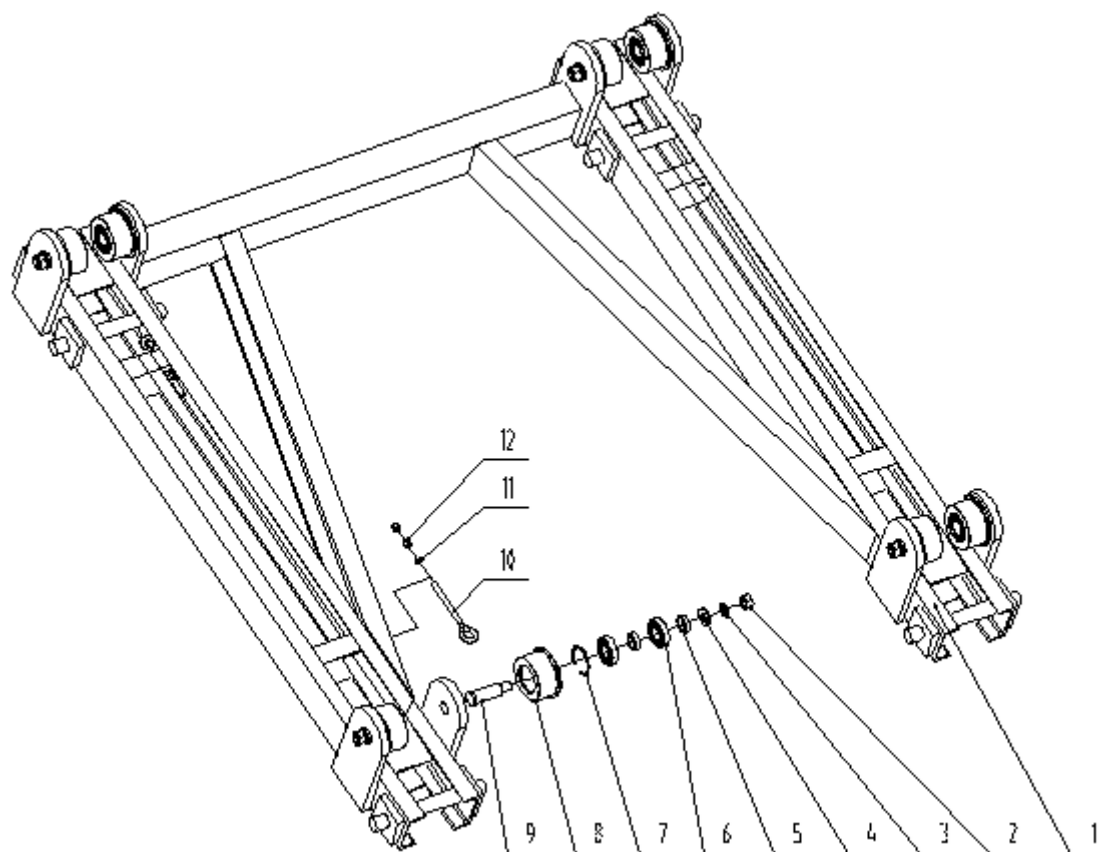


Fig. 7-54 000201108B0000100

Table 7-54 Spare parts list of Mounting Trolley

No.	Order No.	Code	Designation	Specification	Qty
1	000201108B0000110		Trolley frame		1
2	1040200197	GB/T6170-2000	Nut	M30-8	8
3	1040300010	GB/T93-1987	Washer	30	8
4	000200910A0000559		Base plate	t10	8
5	000200910A0000555		Locating sleeve		16
6	1050200498	GB/T276-1994	Deep groove ball bearing	6208-Z	16
7	1040300322	GB/T893.2-1986	Retainer ring	80	8
8	000200910A0000512		Roller		8
9	000200910A0000552		Roller shaft		8
10	000201108B0000101		Hook		4
11	1040300041	GB/T97.1-2002	Washer	12-200HV	4
12	1040200096	GB/T6170-2000	Nut	M12-8	8

7.14.2 Lifting Frame

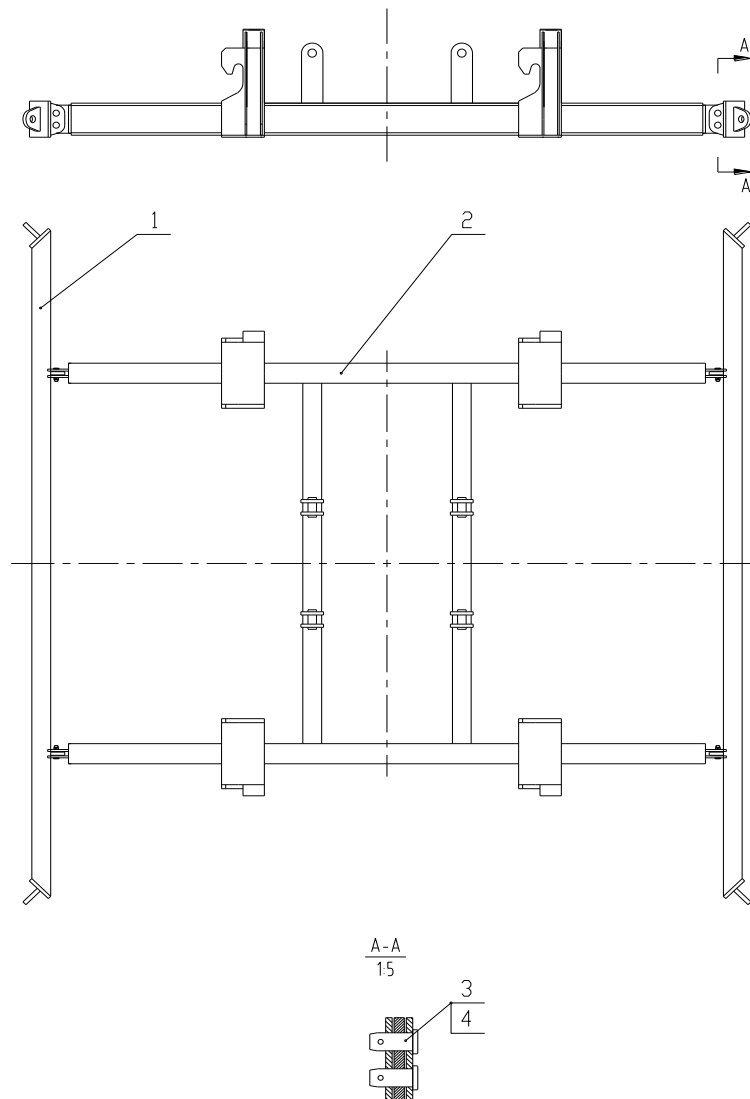


Fig. 7-55 000283019AR030000

Table 7-55 Spare parts list of Lifting Frame

No.	Order No.	Code	Designation	Specification	Qty
1	000283019AR030100		Lifting beam		2
2	000283019AR030200		Support frame		1
3	000209910A1060501	XZ01B-30×50/75	Pin	30×50	8
4	1040500217	GB/T91-2000	Pin	8×63	8

7.14.3 Pulley Assembly

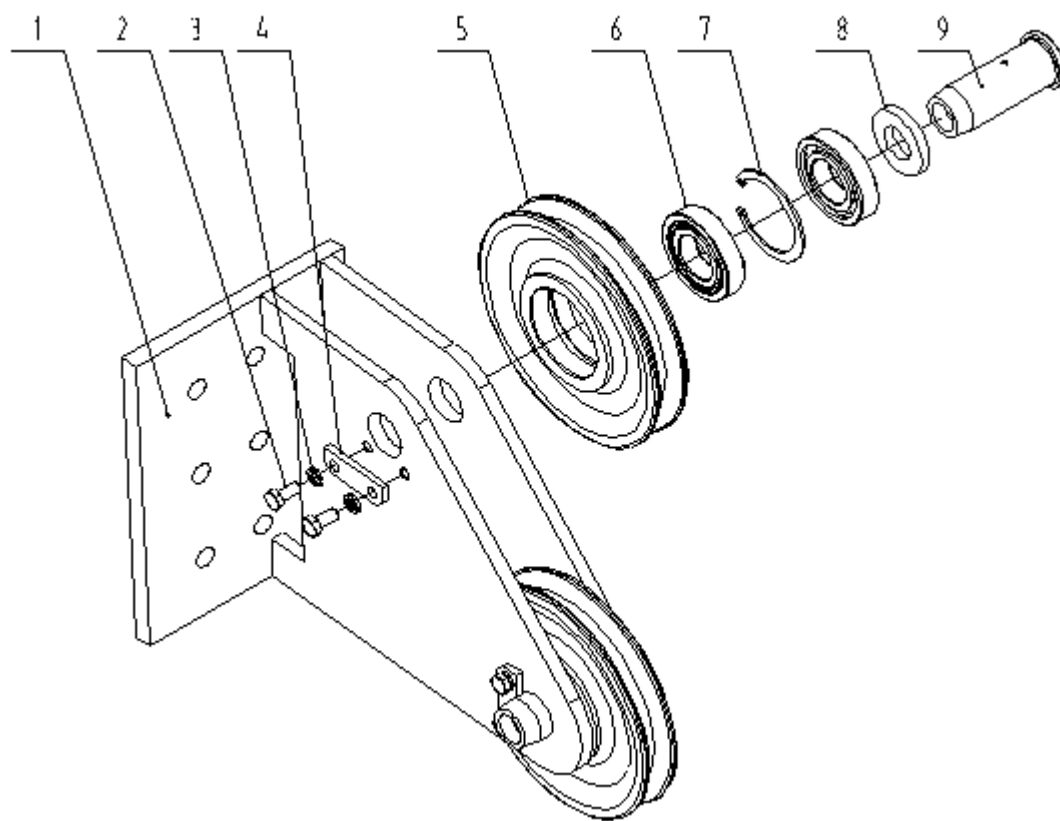
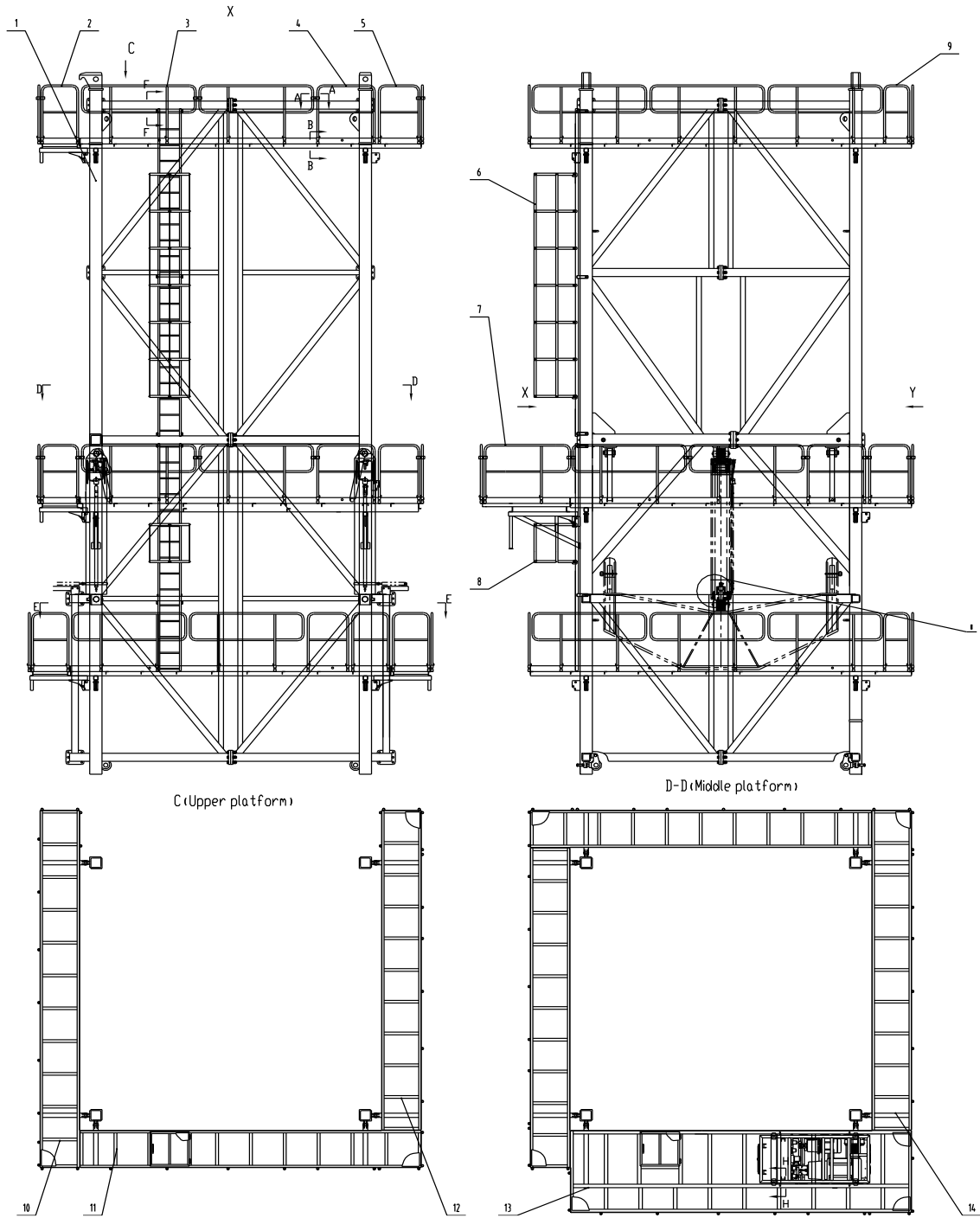


Fig. 7-56 000201108B0000900

Table 7-56 Spare parts list of Pulley Assembly

No.	Order No.	Code	Designation	Specification	Qty
1	000201108B0000910		Pulley seat		1
2	1040000116	GB/T5783-2000	Bolt	M10×20-8.8	4
3	1040300067	GB/T93-1987	Washer	10	4
4	000200305A0000163	TC5613A.05-27	Shaft-end baffle		2
5	000209906A0017000	214-178-B41-80-R6	Pulley		2
6	1050200498	GB/T276-1994	Deep groove ball bearing	6208-z	4
7	1040300322	GB/T893.2-1986	Retainer ring	80	4
8	000200305A0000160	TC5613A.05-24	Shaft sleeve		4
9	000209910A0000507	XZF-40-68/100	Pin		2

7.15 Climbing Equipment



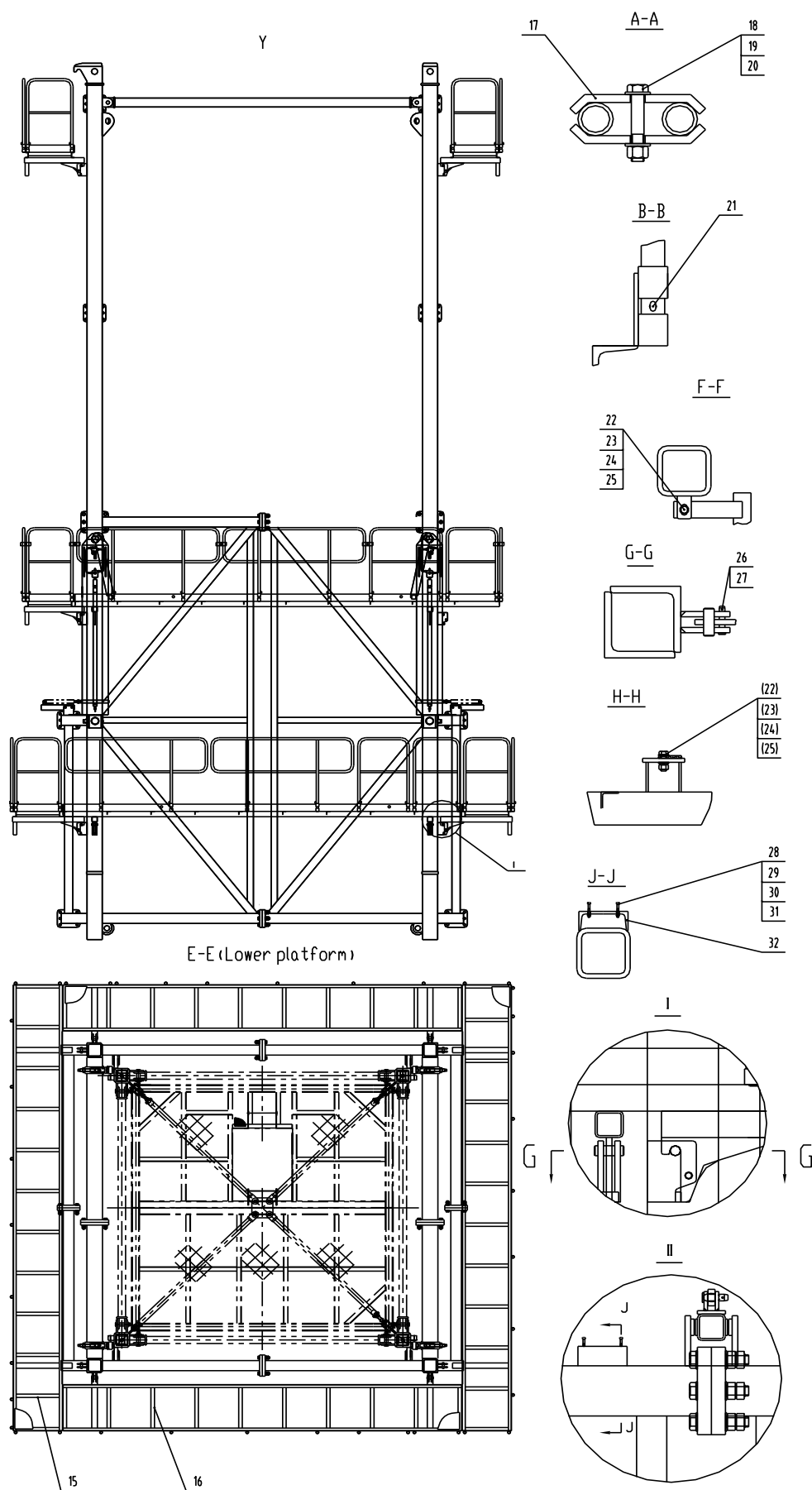


Fig. 7-57 000283011AR000000

Table 7-57 Spare parts list of Climbing Equipment (R1660-80Q.11)

No.	Order No.	Code	Designation	Specification	Qty
1	000283011AR001000		Climbing equipment structure		1
2	000209913C0006300	LGA630B	Railing		15
3	000209913C0020000	LGB2000B	Railing		25
4	000209913D0010000	LGA1000C	Railing		6
5	000209913C0007000	LGA700B	Railing		9
6	000283011AR000100		Ladder I		1
7	000209913C0015000	LGC1500B	Railing		1
8	000283011AR000200		Ladder II		1
9	000209913C0004300	LGA430B	Railing		3
10	000283011AR002000		Platform I		1
11	000283011AR003000		Platform II		1
12	000283011AR004000		Platform III		1
13	000283011AR005000		Platform IV		1
14	000283011AR006000		Platform V		3
15	000283011AR007000		Platform VI		2
16	000283011AR008000		Platform VII		2
17	000209913A6000000	LGJB2	Railing splint	t6	116
18	1040200096	GB/T6170-2000	Nut	M12-8	58
19	1040300233	GB/T96.1-2002	Washer	12-200HV	58
20	1040000562	GB/T5783-2000	Bolt	M12×65-8.8	58
21	000208899A0002076	TX-6-24/35	Spring pin	Φ6×117	118
22	1040000198	GB/T5783-2000	Bolt	M16×50-8.8	14
23	1040300065	GB/T93-1987	Washer	16	14
24	1040300052	GB/T97.1-2002	Washer	16-200HV	28
25	1040200110	GB/T6170-2000	Nut	M16-8	14
26	000209910A0160701	XZ01B-16×70/85	Pin	16×70	22
27	1040500097	GB/T91-2000	Split pin	4×30	22
28	1040100353	GB/T70.1-2000	Screw	M5×40-8.8	8
29	1040300048	GB/T97.1-2002	Washer	5-200HV	8
30	1040300060	GB/T93-1987	Washer	5	8
31	1040200734	GB/T6170-2000	Nut	M5-8	8
32	000263011AT000001		Installing seat	[14b	2

7.16 Tower Section

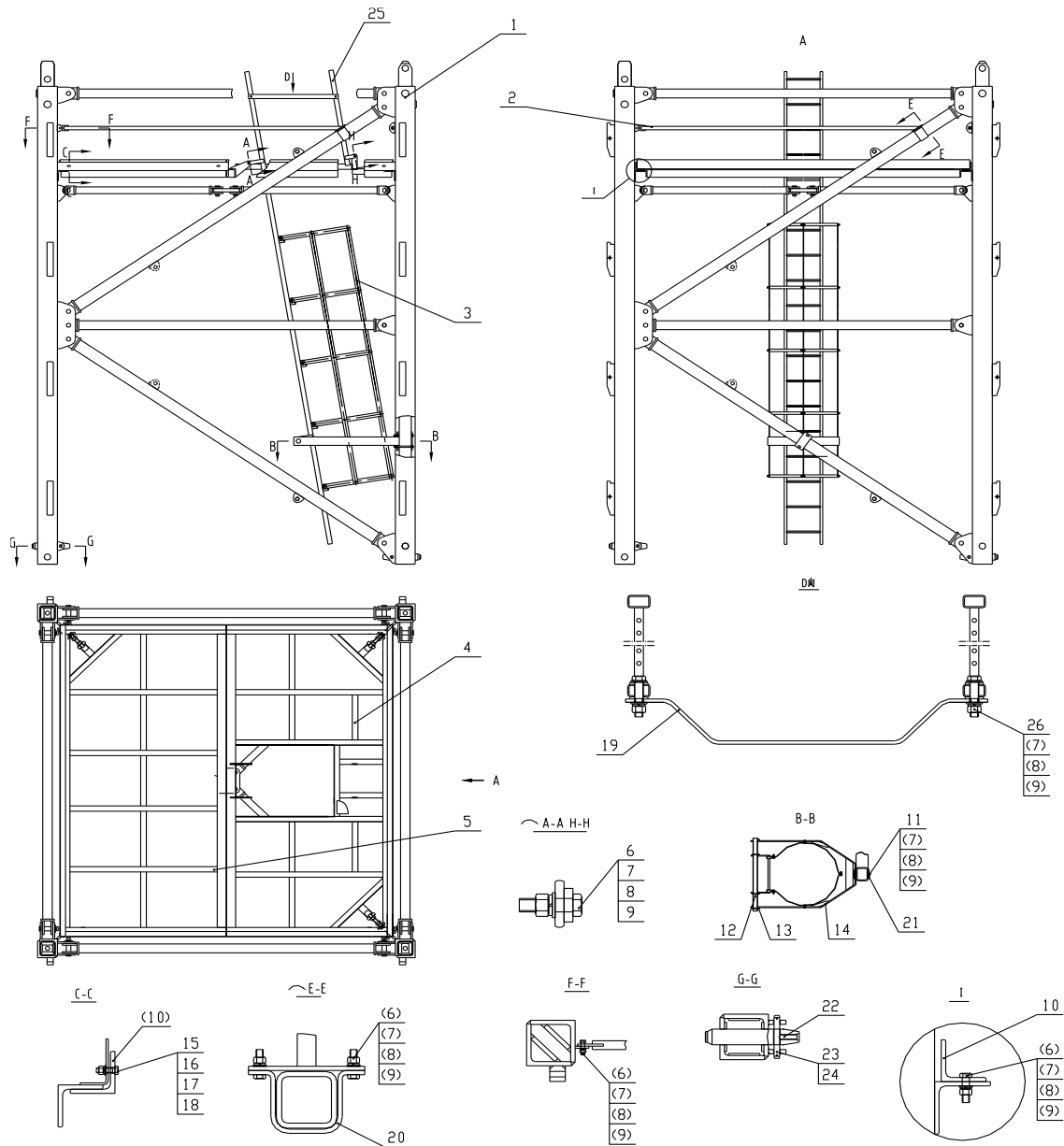


Fig. 7-58 000209016A0500000

Table 7-58 Spare parts list of Tower Section (X42D)

No.	Order No.	Code	Designation	Specification	Qty
1	000209016A0510000		Tower section structure		1
2	000209016A0420000		Cross rod		4
3	000209016A0530000		Ladder and guard ring		1
4	000209016A0503000		Platform A		1
5	000209016A0203400		Platform D		1
6	1040000095	GB/T5783-2000	Bolt	M16×60-8.8	20
7	1040300052	GB/T97.1-2002	Washer	16-200HV	24
8	1040300065	GB/T93-1987	Washer	16	24
9	1040200110	GB/T6170-2000	Nut	M16-8	24
10	000209016A0200001		Bearing angle steel	L100×10	2
11	1040001326	GB/T5782-2000	Bolt	M16×200-8.8	2
12	000209016A0504000		Ladder blocking rod		1
13	1040500244	GB/T91-2000	Split pin	10×71	3
14	000209016A0460000		Ladder support		1
15	1040000169	GB/T5783-2000	Bolt	M12×45-8.8	8
16	1040300041	GB/T97.1-2002	Washer	12-200HV	8
17	1040300054	GB/T93-1987	Washer	12	8
18	1040200096	GB/T6170-2000	Nut	M12-8	8
19	000209016A0500001		Ladder supporting plate	t8	1
20	000209016A0400001		Clamp	t10	4
21	000209016A0400002		Connecting plate	t12	2
22	000209016A0400003		Pin	75×290	8
23	000209910A4051751	XZ03A- 25×175/205	Pin	25×175	8
24	1040501339	DIN_11024	Spring pin	d1=6.3	16
25	000209016A0502000		Short ladder		1
26	1040000526	GB/T5782-2000	Bolt	M16×80-8.8	2

7.17 Base Tower Section

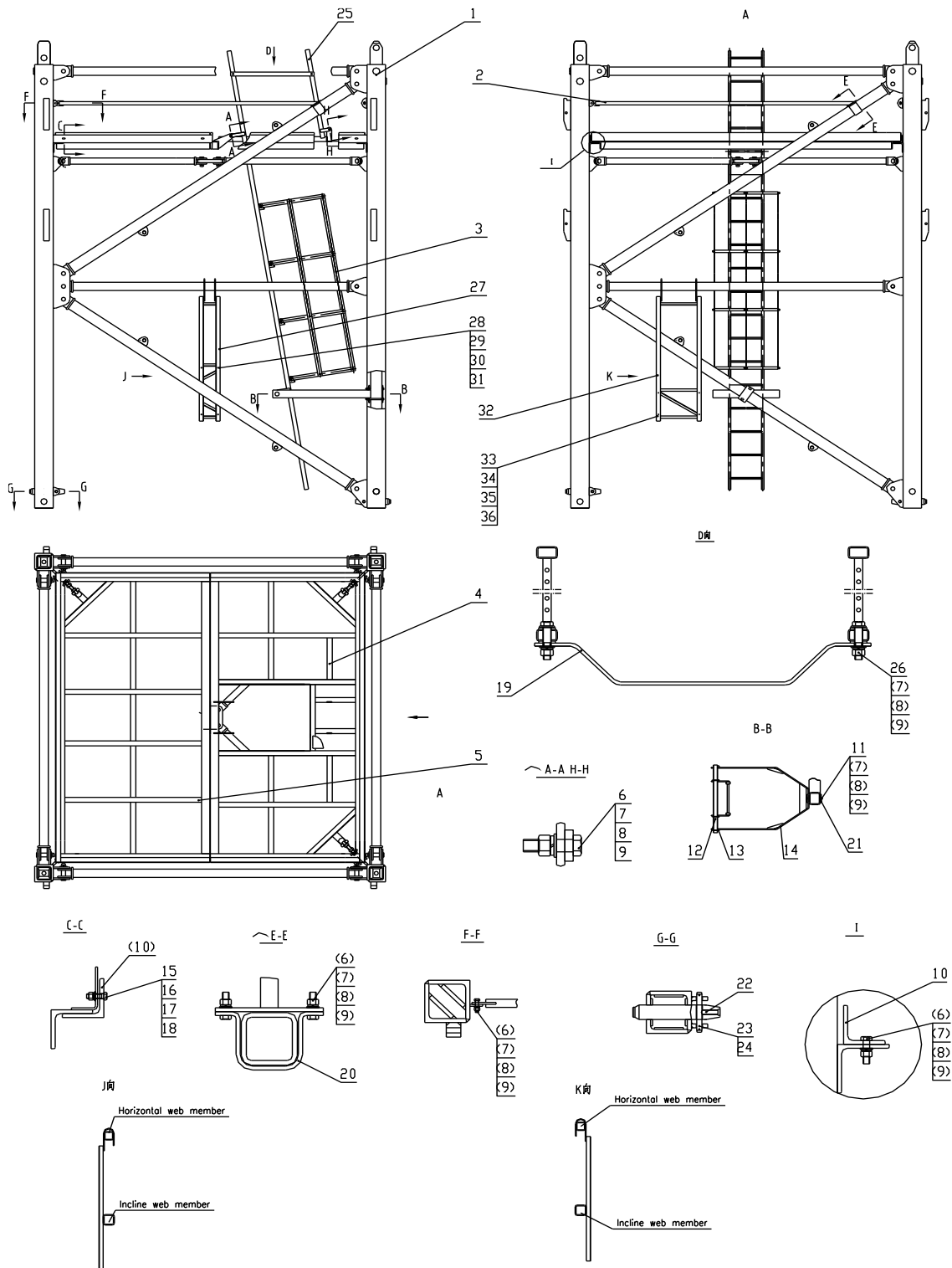


Fig. 7-59 000209016A0600000

Table 7-59 Spare parts list of Base Tower Section (X42Rb)

No.	Order No.	Code	Designation	Specification	Qty
1	000209016A0510000		Tower section structure		1
2	000209016A0420000		Cross rod		4
3	000209016A0530000		Ladder and guard ring		1
4	000209016A0503000		Platform A		1
5	000209016A0203400		Platform D		1
6	1040000095	GB/T5783-2000	Bolt	M16×60-8.8	20
7	1040300052	GB/T97.1-2002	Washer	16-200HV	24
8	1040300065	GB/T93-1987	Washer	16	24
9	1040200110	GB/T6170-2000	Nut	M16-8	24
10	000209016A0200001		Bearing angle steel	L100×10	2
11	1040001326	GB/T5782-2000	Bolt	M16×200-8.8	2
12	000209016A0504000		Ladder blocking rod		1
13	1040500244	GB/T91-2000	Split pin	10×71	3
14	000209016A0460000		Ladder support		1
15	1040000169	GB/T5783-2000	Bolt	M12×45-8.8	8
16	1040300041	GB/T97.1-2002	Washer	12-200HV	8
17	1040300054	GB/T93-1987	Washer	12	8
18	1040200096	GB/T6170-2000	Nut	M12-8	8
19	000209016A0500001		Ladder supporting plate	t8	1
20	000209016A0400001		Clamp	t10	4
21	000209016A0400002		Connecting plate	t12	2
22	000209016A0400003		Pin	75×290	8
23	000209910A4051751	XZ03A-25×175/205	Pin	25×175	8
24	1040501339	DIN_11024	Spring pin	d1=6.3	16
25	000209016A0502000		Short ladder		1
26	1040000526	GB/T5782-2000	Bolt	M16×80-8.8	2
27	000209016A0600100		Knife switch box support		1
28	1040000018	GB/T5783-2000	Bolt	M8×30-8.8	4
29	1040200744	GB/T6170-2000	Nut	M8-8.8	4
30	1040300063	GB/T93-1987	Washer	8	4
31	1040300066	GB/T97.1-2002	Washer	8-200HV	4
32	000209016A0600200		Nameplate support		1
33	1040000109	GB/T5783-2000	Bolt	M6×16-8.8	4
34	1040200111	GB/T6170-2000	Nut	M6-8	4
35	1040300062	GB/T93-1987	Washer	6	4
36	1040300051	GB/T97.1-2002	Washer	6-200HV	4

7.18 Outrigger

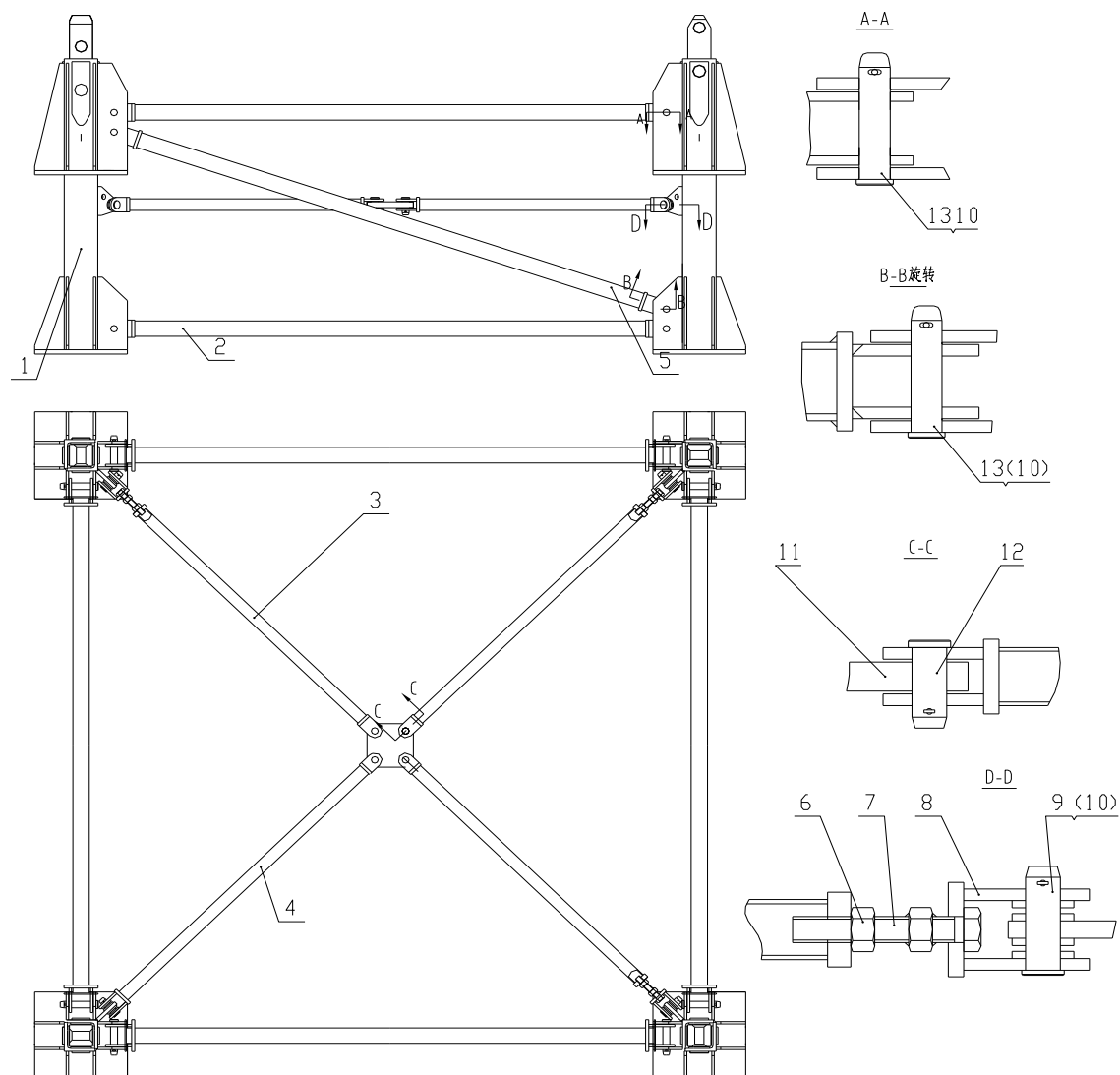


Fig. 7-60 000201115A1000000

Table 7-60 Spare parts list of Base Tower Section (D1100.15A)

No.	Order No.	Code	Designation	Specification	Qty
1	000201315A2000100		Outrigger		4
2	000201115A1000020		Straight web member		8
3	000201113B0001200		Adjusting strut		3
4	000201113B0001300		Strut		1
5	000201115A1000030		Incline web member		4
6	1040200276	GB/T6170-2000	Nut	M36-8	3
7	000201113B0001500		Adjusting screw		3
8	000201113B0001600		U-plate		3
9	000201113B0001010		Pin A		4
10	1040500381	GB/T91-2000	Split pin	8×71	32
11	000201113B0001020		Connecting plate		1
12	000201113B0001030	XZ01C-45×90/130	Pin B	45×90	4
13	000209015A4005000	XZ01C-45×205/245	Pin	45×205	24

7.19 Chassis

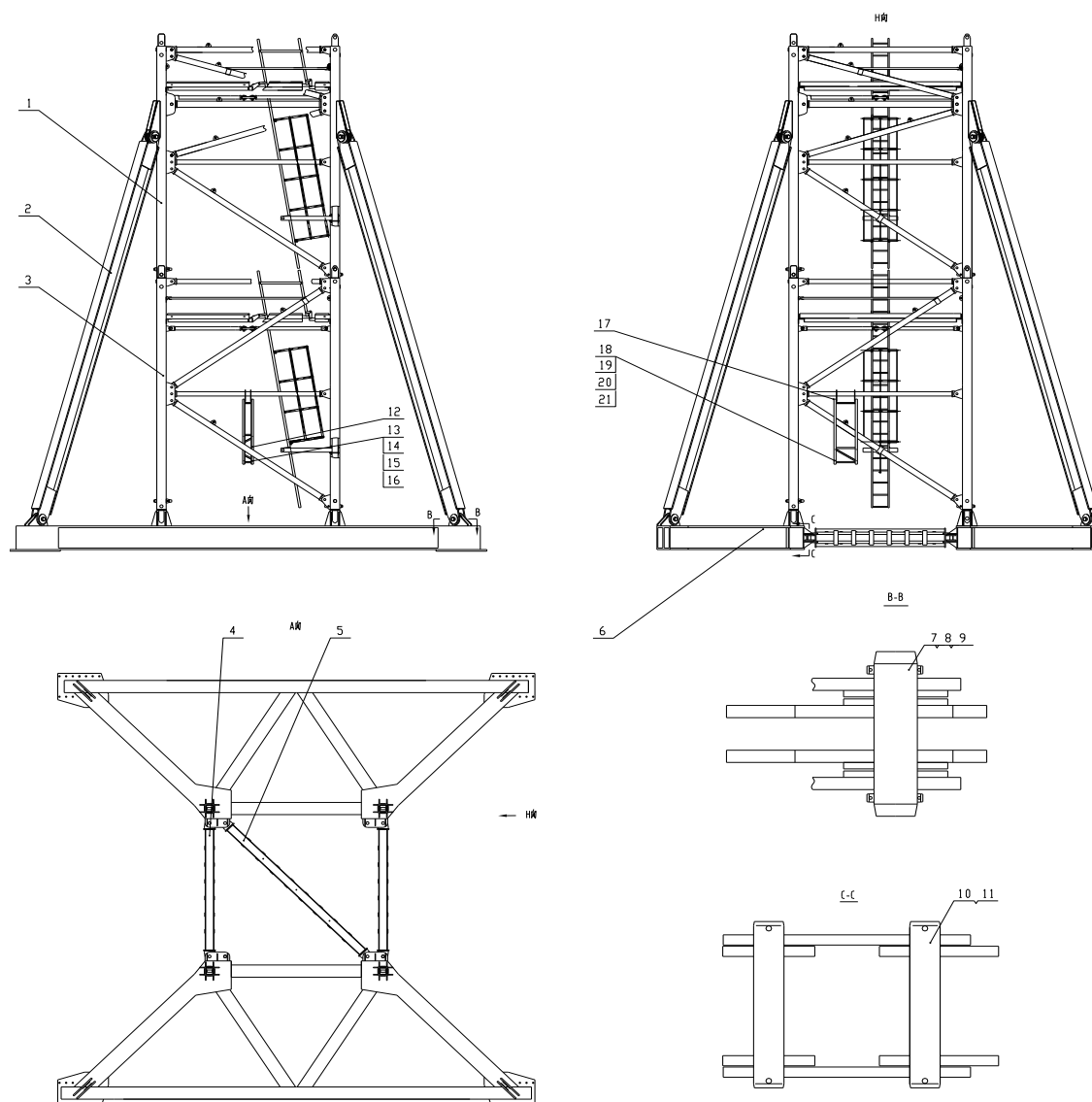


Fig. 7-61 000201114AH000000

Table 7-61 Spare parts list of Chassis (D1100.14B)

No.	Order No.	Code	Designation	Specification	Qty
1	000201114AH100000		Base tower section II		1
2	000201114B0005000		Strut		4
3	000201114AH200000		Base tower section I		1
4	000201114B0008000		Straight strut		2
5	000201114B0007500		Incline strut		1
6	000201114B0009100		Piece beam		2
7	000209910A4203151	XZ03E- 100×315/405	Pin	100×315	8
8	000201114B0000002		Lock pin		16
9	1040500223	GB/T91-2000	Split pin	6.3×40	32
10	000201114B0000005		Pin	70×375	6
11	1040500247	GB/T91-2000	Split pin	13×125	12
12	000209016A0600100		Knife switch box support		1
13	1040000018	GB/T5783-2000	Bolt	M8×30-8.8	4
14	1040200744	GB/T6170-2000	Nut	M8-8.8	4
15	1040300063	GB/T93-1987	Washer	8	4
16	1040300066	GB/T97.1-2002	Washer	8-200HV	4
17	000209016A0600200		Nameplate support		1
18	1040000109	GB/T5783-2000	Bolt	M6×16-8.8	4
19	1040200111	GB/T6170-2000	Nut	M6-8	4
20	1040300062	GB/T93-1987	Washer	6	4
21	1040300051	GB/T97.1-2002	Washer	6-200HV	4

Technical drawing of a machine tool, showing multiple views and numbered callouts (1-80). The drawing includes a side view (top), a front view (middle), and a detailed view of the tool head (bottom right). The machine features a large base, a vertical column, and a horizontal tool head. The tool head is equipped with a motor and various mechanical components. The drawing is labeled with various letters (A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z) and numbers (1-80) indicating specific parts and features. The text "Electric control cabinet" is visible on the side view. The drawing is oriented horizontally on the page.

Fig. 7-62 000209410B0100000

Table 7-62 Spare parts list of Travelling Bogie I (ZA110-B)

No.	Order No.	Code	Designation	Specification	Qty
1	1040001601	GB/T5782-2000	Bolt	M30×150-8.8	6
2	1040300074	GB/T97.1-2002	Washer	30-200HV	12
3	1040300010	GB/T93-1987	Washer	30	6
4	1040200197	GB/T6170-2000	Nut	M30-8	6
5	000209410A0100010		Shaft-end baffle		2
6	1040000287	GB/T5783-2000	Bolt	M20×65-8.8	28
7	1040300106	GB/T97.1-2002	Washer	20-200HV	48
8	1040300038	GB/T93-1987	Washer	20	56
9	000209410A0100100		Balance beam		1
10	000209410A0100200		Support		1
11	000209410A0100015		Pin		1
12	1080000206	JB/T7940.1-1995	Oil cup	M10×1	20
13	1040001601	GB/T5783-2000	Bolt	M20×60-8.8	4
14	1040300074	GB/T1096-2003	Bond	20×250	1
15	1040300010		Hinged fork		2
16	1040200197		Shaft		2
17	000209410A0100010	KA/T97B-50-AG160	Reducer with connecting flange		1
18	1040000287		Shaft		1
19	1040300106	GB/T893.2-1986	Retainer ring	180	1
20	1040300038	GB/T276-1994	Deep-groove ball bearing	6220-2RZ	1
21	000209410A0100100	GB/T1096-2003	Bond	22×100	1
22	000209410A0100200		Small gear		1
23	000209410A0100015		Big gear		2
24	1080000206	GB/T894.2-1986	Retainer ring	85	1
25	1040000055	XCR-F17	Travel switch		1
26	1040600139	GB/T5783-2000	Bolt	M5×60-8.8	4
27	000209410A0100300	GB/T93-1987	Washer	5	6
28	000209410A0100020	GB/T97.1-2002	Washer	5-200HV	6
29	1030200677	GB/T6170-2000	Nut	M5-8	4
30	000209410A0100025	GB/T276-1994	Deep-groove ball bearing	6214-2RZ	1
31	1040300644	GB/T893.2-1986	Retainer ring	125	1
32	1050200426	GB/T812-1988	Nut	M64×2	1
33	1040600180	GB/T858-1988	Washer	64	1
34	000209410A0100030		Steel sleeve		4
35	000209410A0100035		Anchoring device		1
36	1040300775		Steel sleeve		2
37	1020500695	D4N-4132	Travel switch		1
38	1040001592	GB/T5783-2000	Bolt	M4×35-8.8	2

No.	Order No.	Code	Designation	Specification	Qty
39	1040300060	GB/T93-1987	Washer	4	2
40	1040300048	GB/T97.1-2002	Washer	4-200HV	4
41	1040200107	GB/T6170-2000	Nut	M4-8	2
42	1050200425		Installing angle steel		1
43	1040300776		Outrigger I		4
44	1040200466	GB/T5783-2000	Bolt	M20×40-8.8	16
45	1040300418		Shaft-end baffle		12
46	000209410A0100040	YVFSE3-160M-4	Electromotor		1
47	000209410A0100400	GB/T5783-2000	Bolt	M16×45-8.8	4
48	000209410A0100045	GB/T93-1987	Washer	16	20
49	1020500676	GB/T97.1-2002	Washer	16-200HV	12
50	1040000235		Reducer support		1
51	1040300044	GB/T5783-2000	Bolt	M16×60-8.8	8
52	1040300045	GB/T6170-2000	Nut	M16-8	8
53	1040200100		Rail clamp		3
54	000209410A0100048		Shaft sleeve		8
55	000209410A0100600		Powered bogie support		1
56	1040000033		Pin		4
57	000209410A0100050		Bearing-end cover		8
58	1020000150	GB/T5783-2000	Bolt	M12×50-8.8	16
59	1040000065	GB/T93-1987	Washer	12	16
60	1040300065		Screw		8
61	1040300052	GB/T6170-2000	Nut	M20-8	8
62	000209410A0100060		Washer		16
63	1040000095		Felt collar		8
64	1040200110		Powered wheel		2
65	000209410A0100500	GB/T283-1994	Cylindrical roller bearing	NJ232	8
66	000209410A0100065		Steel sleeve		4
67	000209410B0100100		Idler wheel		2
68	000209410A0100070		Shaft sleeve		4
69	000209410A0100075		Outrigger II		4
70	1040000149		Idler bogie support		1
71	1040300054	GB/T5782-2000	Bolt	M24×85-10.9	8
72	000209410A0100080	GB/T97.1-2000	Washer	24-200HV	16
73	1040200097	GB/T93-1987	Washer	24	8
74	000209410A0100001	GB/T6170-2000	Nut	M24-8	8
75	000209410A0100085	YJJ200-L	Hydraulic rail clamp		1
76	000209410A0100900		Inserting pin		1
77	1050200465	JB/T8108.2-1999	Hoisting chain	Φ5	3
78	000209410A0100090		Warning light seat		1
79	000209410A0101000	GB/T5783-2000	Bolt	M5×16-8.8	2
80	000209410A0100095	HS3-460	Buffer		1

7.21 Travelling Bogie II

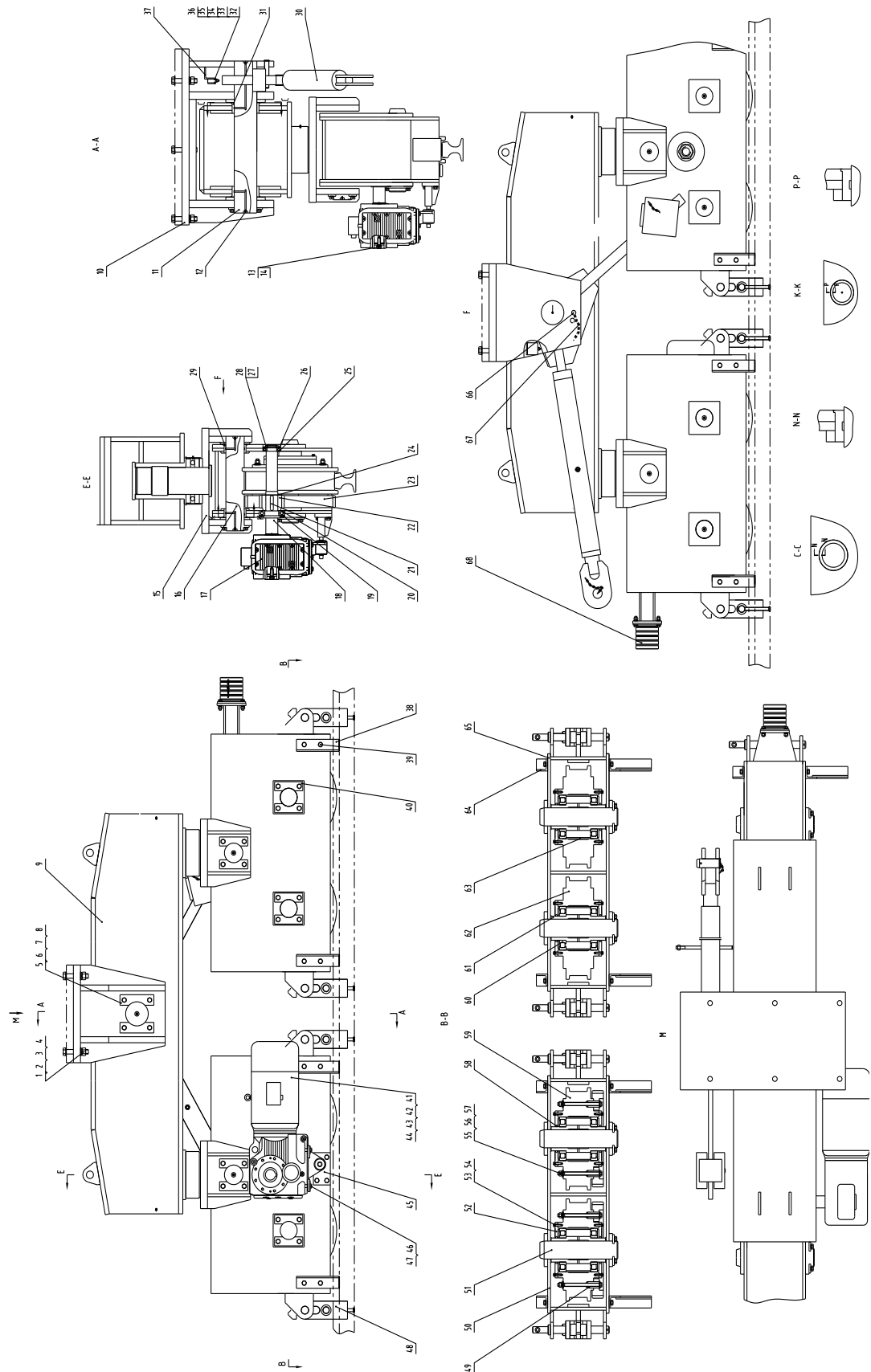


Fig. 7-63 000209410B0200000

Table 7-63 Spare parts list of Travelling Bogie II (ZB110-B)

No.	Order No.	Code	Designation	Specification	Qty
1	1040001601	GB/T5782-2000	Bolt	M30×150-8.8	6
2	1040300074	GB/T97.1-2002	Washer	30-200HV	12
3	1040300010	GB/T93-1987	Washer	30	6
4	1040200197	GB/T6170-2000	Nut	M30-8	6
5	000209410A0100010		Shaft-end baffle		2
6	1040000287	GB/T5783-2000	Bolt	M20×65-8.8	28
7	1040300106	GB/T97.1-2002	Washer	20-200HV	48
8	1040300038	GB/T93-1987	Washer	20	56
9	000209410A0100100		Balance beam		1
10	000209410A0100200		Support		1
11	000209410A0100015		Pin		1
12	1080000206	JB/T7940.1-1995	Oil cup	M10×1	20
13	1040000055	GB/T5783-2000	Bolt	M20×60-8.8	4
14	1040600139	GB/T1096-2003	Bond	20×250	1
15	000209410A0100300		Hinged fork		2
16	000209410A0100020		Shaft		2
17	1030200677	KA/T97B-50-AG160	Reducer with connecting flange		1
18	000209410A0100025		Shaft		1
19	1040300644	GB/T893.2-1986	Retainer ring	180	1
20	1050200426	GB/T276-1994	Deep-groove ball bearing	6220-2RZ	1
21	1040600180	GB/T1096-2003	Bond	22×100	1
22	000209410A0100030		Small gear		1
23	000209410A0100035		Big gear		2
24	1040300775	GB/T894.2-1986	Retainer ring	85	1
25	1050200425	GB/T276-1994	Deep-groove ball bearing	6214-2RZ	1
26	1040300776	GB/T893.2-1986	Retainer ring	125	1
27	1040200466	GB/T812-1988	Nut	M64×2	1
28	1040300418	GB/T858-1988	Washer	64	1
29	000209410A0100040		Steel sleeve		4
30	000209410A0100400		Anchoring device		1
31	000209410A0100045		Steel sleeve		2
32	1020500676	D4N-4132	Travel switch		1
33	1040000235	GB/T5783-2000	Bolt	M4×35-8.8	2

No.	Order No.	Code	Designation	Specification	Qty
34	1040300044	GB/T93-1987	Washer	4	2
35	1040300045	GB/T97.1-2002	Washer	4-200HV	4
36	1040200100	GB/T6170-2000	Nut	M4-8	2
37	000209410A0100048		Installing angle steel		1
38	000209410A0100600		Outrigger I		4
39	1040000033	GB/T5783-2000	Bolt	M20×40-8.8	16
40	000209410A0100050		Shaft-end baffle		12
41	1020000150	YVFSE3-160M-4	Electromotor		1
42	1040000065	GB/T5783-2000	Bolt	M16×45-8.8	4
43	1040300065	GB/T93-1987	Washer	16	12
44	1040300052	GB/T97.1-2002	Washer	16-200HV	20
45	000209410A0100060		Reducer support		1
46	1040000095	GB/T5783-2000	Bolt	M16×60-8.8	8
47	1040200110	GB/T6170-2000	Nut	M16-8	8
48	000209410A0100500		Rail clamp		4
49	000209410A0100065		Shaft sleeve		8
50	000209410B0200100		Powered bogie support		1
51	000209410A0100070		Pin		4
52	000209410A0100075		Bearing-end cover		8
53	1040000149	GB/T5783-2000	Bolt	M12×50-8.8	16
54	1040300054	GB/T93-1987	Washer	12	16
55	000209410A0100080		Screw		8
56	1040200097	GB/T6170-2000	Nut	M20-8	8
57	000209410A0100001		Washer		16
58	000209410A0100085		Felt collar		8
59	000209410A0100900		Powered wheel		2
60	1050200465	GB/T283-1994	Cylindrical roller bearing	NJ232	8
61	000209410A0100090		Steel sleeve		4
62	000209410A0101000		Idler wheel		2
63	000209410A0100095		Shaft sleeve		4
64	000209410A0101100		Outrigger II		4
65	000209410B0200200		Idler bogie support		1
66	000209410A0100098		Inserting pin		1
67	1090100321	JB/T8108.2-1999	Hoisting chain	Φ5	3
68	1990400158	HS3-460	Buffer		1

7.22 Cable Drum

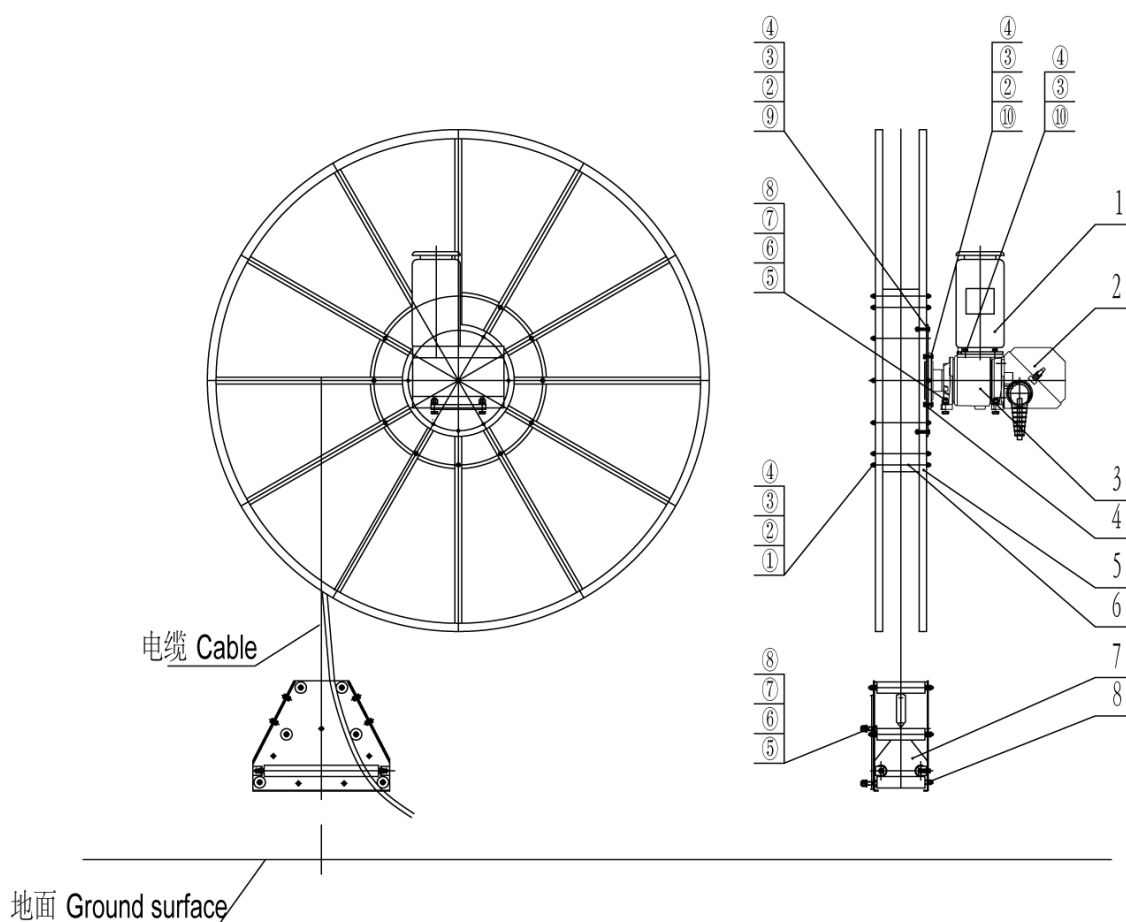


Fig. 7-64 000209940A0000010

Table 7-64 Spare parts list of Cable Drum (M822)

No.	Order No.	Code	Designation	Specification	Qty
1	1020004122	YLJ112-16N.m-4KW	Electric motor		1
2	1029901693	K530	Collector ring		1
3	1030200866	WC97.5-60	Reducer		1
4	1029903916	8YWD.180.008	Flange		1
5	1029903914	5YWD.223.004	Plate		2
6	1029903915	5YWD.089.003.1	Frame		1
7	1029903913	5YWD.269.003	Roller box		1
8	000209940A0000011		Bolt package		1

7.22.1 Bolt Package

Table 7-65 Spare parts list of Bolt Package (000209940A0000011)

No.	Order No.	Code	Designation	Specification	Qty
1	1040003346	8YWD.932.012	Threaded rod	M10260	12
2	1040200113	GB/T6170-2000	Nut	M10-8	48
3	1040300061	GB/T97.1-2002	Washer	10-200HV	52
4	1040300067	GB/T93-1987	Washer	10	52
5	1040000095	GB/T5783-2000	Bolt	M1660-8.8	7
6	1040200110	GB/T6170-2000	Nut	M16-8	7
7	1040300052	GB/T97.1-2002	Washer	16-200HV	7
8	1040300065	GB/T93-1987	Washer	16	7
9	1040000167	GB/T5783-2000	Nut	M1055-8.8	12
10	1040000122	GB/T5783-2000	Nut	M1035-8.8	16

(THE END)

Thanks for your reading!